



#12 Appeal Brief
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 09/635,956
Applicant : Timothy C. Loose
Filed : August 10, 2000
Title : SLOT MACHINE REEL MECHANISM WITH
DEDICATED LOCAL MICROCONTROLLER
TC/A.U. : 3714
Examiner : Corbett B. Coburn
Docket No. : 47079-00058

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APPEAL BRIEF PURSUANT TO 37 C.F.R. §§ 1.191 AND 1.192

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Adrienne White

Dear Commissioner:

This Appeal Brief is filed pursuant to the Applicant's appeal to the Board of Patent Appeals and Interferences from the final rejection of claims 1-5, 7-23, and 27-29. The due date for this Appeal Brief is May 25, 2003. The Applicant is submitting herewith a petition for a one-month extension of time under 37 C.F.R. § 1.136(a) to extend the due date for this Appeal Brief up to and including June 25, 2003. This Appeal Brief is being filed prior to that date.

1. THE REAL PARTY IN INTEREST

The real party in interest is WMS Gaming Inc. have a place of business at 3401 North California Avenue, Chicago, Illinois 60618.

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2. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board of Patent Appeals and Interferences in the present appeal.

3. STATUS OF CLAIMS

Claims 1-5, 7-23, and 27-29 are currently pending in the above-referenced application. Claims 6 and 24-26 have been cancelled. No claims have been allowed.

The Applicant appeals from the final rejection of claims 1-5, 7-23, and 27-29. Claims 1-5, 7-23, 27, and 28 have been rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,394,900 to McGlone et al. Claim 29 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over McGlone in view of U.S. Patent No. 6,315,663 to Sakamoto.

A copy of the appealed claims is attached as Appendix A. Copies of the McGlone patent and the Sakamoto patent are attached as Appendices B and C, respectively. A copy of the Office Action mailed December 20, 2002 that finally rejected the claims is attached as Appendix D.

4. STATUS OF AMENDMENTS

The Applicant filed an Amendment After Final, mailed on February 19, 2003, in response to the office action mailed December 20, 2002 (Appendix D). In an advisory action mailed March 7, 2003, the Examiner indicated that this amendment would be entered. The appealed claims (Appendix A) reflect this amendment. A copy of advisory action mailed March 7, 2003 is attached as Appendix E.

5. SUMMARY OF INVENTION

The Applicant's invention is directed to a slot machine 10 that includes a central processing unit ("CPU") 60 for operating the gaming machine 10 in response to a wager and a distinct local microcontroller 50 for performing the low-level reel driver operations associated with the operation of a reel mechanism (FIG. 2) of the gaming machine 10 independent of the CPU 60. The reel mechanism includes a stepper motor 36, a symbol-bearing reel 12,14,16, and a reel driver. The stepper motor 36 includes a rotatable shaft 40 to which the reel 12,14,16 is attached. The slot machine 10 includes a reel mechanism for each of the three symbol-bearing

reels 12,14,16. Generally, the Applicant's invention shifts the low-level reel driver operations previously performed by the CPU 60 of prior art slot machines to a local microcontroller. This provides the advantage of freeing-up the slot machine's CPU 60 for better performing other tasks such as processing data resulting in increasing the overall speed of the game.

FIG. 3 of the Applicant's specification shows a block diagram functionally illustrating the Applicant's invention. The CPU 60 is coupled to the local microcontroller 50 via a serial interface 52. The local microcontroller 50 interfaces with the various components of the reel mechanism (FIG. 2) including the motor driver 54 and the detector interface 56.

I. Summary of Independent Claims 1, 9, and 20

Independent claims 1, 9, and 20 are directed to a slot machine 10 or methods for configuring a slot machine 10 that comprise a CPU 60 for operating the slot machine 10 in response to a wager, and includes a reel mechanism (FIG. 2). The reel mechanism (FIG. 2) includes a motor 36, a symbol-bearing reel 12,14,16, and a reel driver. The motor 36 includes a rotatable shaft 40 to which the reel 12,14,16 is mounted. The reel driver includes a local microcontroller 50 distinct from and coupled to the CPU 60. The reel driver is coupled to the motor 36 to cause the motor 36 to rotate the reel. The local microcontroller 50 performs low-level reel driver operations independent from the CPU 60.

The CPU 60 sends configuration data to the local microcontroller 50 for configuring the local microcontroller 50 to a reel spinning game conducted with the slot machine 10. *See* the Applicant's Specification at page 5, lines 27—page 6, line 2. The configure data includes information such as, for example, whether the slot machine is a "slant top" or "upright," the number of symbols on the reel, the number of steps in the motor, and how to drive the motor. *Id.* This step is part of various verification processes executed by the CPU 60 to ensure that the slot machine 10 is in working order. *Id.*

II. Summary of Independent Claim 12

Independent claim 12 is directed to a slot machine 10 that comprises a motor 36 including a rotatable shaft 40, a symbol-bearing reel 12,14,16 mounted to said shaft 40, a reel driver coupled to the motor 36 for causing the motor 36 to rotate the reel 12,14,16, and a CPU 60. The reel driver includes a local microcontroller 50. The CPU 60 issues a start spin command and a

stop command to the reel driver. The start spin command instructs the reel driver to cause the motor 36 to rotate the reel 12,14,16. *Id.* at page 6, lines 17-24. The stop command instructs the reel driver to stop the motor 36 from rotating the reel at a specified stop position. *Id.* at page 6, line 31—page 7, line 6. The local microcontroller 50 monitors the reel 12,14,16 in real time and at least partially controls position of the reel 12,14,16 after the start spin command and prior to the stop command. *Id.* at page 6, line 17—page 7, line 6. The CPU 60 sends configuration data to the local microcontroller 50 for configuring the local microcontroller 50 to a reel spinning game conducted with the slot machine 10. *Id.* at page 5, lines 27—page 6, line 2

III. Summary of Dependent Claims 15, 17, 19, and 22

Dependant claims 15, 17, 19, and 22 depend from independent claims 1, 9, 12, and 20, respectively. These dependant claims are directed to an apparatus or method wherein the local microcontroller 50, in response to the receipt of the configuration data from the CPU 60, processes the configuration data and reports a status of configuration back to the CPU. *Id.* This processing and reporting back is an example of one of the verifications processes to ensure that the slot machine 10 is in working order. *Id.*

IV. Summary of Independent Claim 23

Independent claim 23 is directed to a method of configuring a slot machine 10 to a reel spinning game conducted with the slot machine 10. The method includes providing a physical symbol-bearing reel 12,14,16, that includes an encoder 44 that indicates a position of the reel, a reel controller 50 for performing low-level operations related to movement of the reel 12,14,16, and a CPU 60 for issuing high-level commands to the reel controller 50. *Id.* at page 4, line 16—page 5, line 2. The high-level commands are related to the movement of the reel 12,14,16. *Id.* at page 5, lines 16-21. A command is sent from the CPU 60 to the reel controller 50 to determine the type of encoder 44 of the reel 12,14,16. *Id.* at page. 6, lines 3-16. Configuration data is sent from the CPU 60 to the reel controller 50 for configuring the reel controller 50 to the reel spinning game. *Id.* at page 5, lines 27—page 6, line 2. The reel controller 50 compares the determined type of encoder with the configuration data sent by the CPU 60. *Id.* at page. 6, lines 3-16.

V. Summary of Independent Claim 28

Independent claim 28 is directed to a method of configuring a slot machine 10 to a reel spinning game conducted with the slot machine 10. The method includes providing a physical symbol-bearing reel 12,14,16, that includes an encoder 44 that indicates a position of the reel, a reel controller 50 for performing low-level operations related to movement of the reel 12,14,16, and a CPU 60 for issuing high-level commands to the reel controller 50. *Id.* at page 4, line 16—page 5, line 2. The high-level commands are related to the movement of the reel. *Id.* at page 5, lines 16-21. A command is sent from the CPU 60 to the reel controller 50 to determine the type of encoder 44 of the reel 12,14,16. *Id.* at page 6, lines 3-16. The reel controller 50 determines the type of the encoder 44 by causing a motor 36 to spin the reel 12,14,16 and by detecting a physical characteristic of the encoder 44. *Id.*

VI. Summary of Independent Claim 29

Independent claim 29 is directed to a method of configuring a slot machine 10 to a reel spinning game conducted with the slot machine 10. The method includes providing a physical symbol-bearing reel 12,14,16, a reel controller 50 for performing low-level operations related to movement of the reel 12,14,16, and a CPU 60 for issuing high-level commands to the reel controller 50. *Id.* at page 4, line 16—page 5, line 2. The high-level commands include a command for informing the reel controller 50 of an acceleration profile for accelerating the reel 12,14,16 and a deceleration profile for decelerating the reel 12,14,16. *Id.* at page 6, lines 19-21 and 31-33.

6. ISSUES

The two issues in this Appeal are:

(A) Whether claims 1-5, and 7-23, and 27-28 are patentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,394,900 to McGlone et al.?

(B) Whether claim 29 is patentable under 35 U.S.C. § 103(a) over the McGlone Patent in view of U.S. Patent No. 6,135,663 to Sakamoto?

7. GROUPING OF CLAIMS

Claims 1-5 and 7-14, 16, and 18-21 will stand or fall together.

Claims 15, 17, 19, and 22 will stand or fall together.

Claims 23 and 27 will stand or fall together.

Claim 28 will stand or fall by itself.

Claim 29 will stand or fall by itself.

8. ARGUMENT

Claims 1-5, 7-23, 27, and 28 have been rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,394,900 to McGlone et al. Claim 29 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over the McGlone patent in view of U.S. Patent No. 6,135,663 to Sakamoto. The rejections should be reversed because the references do not disclose, teach, or suggest the Applicant's claims 1-5, 7-23, 27, 28, and 29.

I. The Law of Obviousness

Obviousness requires that all the limitations of a claim must be taught or suggested by the prior art. M.P.E.P. § 2143.03 (citing *In re Royka*, 490 F.2d 981, 985, 180 U.S.P.Q. 580, 583 (C.C.P.A. 1974)). A *prima facie* case of obviousness requires three basic criteria:

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.

M.P.E.P. § 2143 (citing *In re Vaeck*, 947 F.2d 488, 493, 20 U.S.P.Q.2d 1438, 1442 (Fed. Cir. 1991)).

Although a prior art reference may be modified to meet the claimed limitation, the resultant modified reference is not obvious unless the prior art also suggests or motivates the desirability of the modification. *In re Mills*, 916 F.2d 680, 682, 16 U.S.P.Q.2d 1430, 1432 (Fed. Cir. 1990) (citing *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984)). Obviousness cannot "be established using hindsight or in view of the teachings or suggestions of

the invention.” *Ex parte Maguire*, 2002 WL 1801466, *4 (Bd. Pat. App. & Inter. 2002) (Appendix F) (quoting *Para-Ordnance Mfg. Inc. v. SGS Importers Int’l Inc.*, 73 F.3d 1085, 1087, 37 U.S.P.Q.2d 1237, 1239 (Fed. Cir. 1995), *cert. denied*, 519 U.S. 822 (1996)). Further, the proposed modification cannot render the prior art “unsatisfactory for its intended purpose” nor can it “change the principle of operation” of a reference. M.P.E.P. § 2143.01 (citing *In re Gordon*, 733 F.2d at 902, 221 U.S.P.Q. at 1127 and *In re Ratti*, 270 F.2d 810, 813, 123 U.S.P.Q. 349, 352 (C.C.P.A. 1959)).

The law of obviousness requires that a reference be considered as a whole, including those portions that teach away from the Applicant’s claimed invention. *See W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.3d 1540, 1550-51, 220 U.S.P.Q. 303, 311 (Fed. Cir. 1983) (“[T]he totality of a reference’s teaching must be considered.”); *see also* M.P.E.P. § 2141.02 (stating that prior art must be considered in its entirety including disclosures that teach away from the claims). Indicia of teaching away in a reference gives insight into the question of obviousness. *Monarch Knitting Mach. Corp. v. Sulzer Morat GMBH*, 139 F.3d 877, 885, 45 U.S.P.Q.2d 1977, 1984 (Fed. Cir. 1998). A prior art reference may be considered to teach away when “a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *Monarch Knitting*, 139 F.3d at 885, 45 U.S.P.Q.2d at 1984 (quoting *In re Gurley*, 27 F.3d 551, 553, 31 U.S.P.Q. 1130, 1131 (Fed. Cir. 1994)).

II. Claims 1-5, 7-23, and 27 Are Patentable Over the McGlone Patent Under 35 U.S.C. § 103

Claims 1-5, 7-23, and 27 are patentable over the McGlone patent under 35 U.S.C. § 103(a) because the McGlone patent does not disclose, teach, or suggest the subject matter of the Applicant’s claims.

A. McGlone Does Not Disclosure, Teach, or Suggest a CPU that Sends Configuration Data to a Local Microcontroller for Configuring the Local Microcontroller

Claims 1-5, 7-23, and 27 require that *the central processing unit (CPU) sends configuration data to the local microcontroller for configuring the local microcontroller to a*

reel spinning game conducted with the slot machine. The McGlone patent does not disclose, teach, or suggest that the CPU sends confirmation data to the local microcontroller. In fact, the McGlone patent teaches away from this feature of the Applicant's claims 1-5, 7-23, and 27.

One advantage of the Applicant's approach, for example, is the elimination of the need to stock several different reel peripherals loaded with specific configuration data. The Applicant's approach enables a component of the reel mechanism (*e.g.*, a motor) to be replaced with a different type of component (*e.g.*, a motor having a different number of steps) without having to replace the rest of the reel mechanism. The new-motor-specific configuration data is then input to the CPU.

Specifically, the McGlone patent discloses that the slot reel peripheral's configuration is stored in a non-volatile memory 616 of the slot reel controller 534 and is loaded into the local microprocessor's volatile memory 608 from the non-volatile memory 618. *See* the McGlone patent at col. 15, lines 25-57; col. 13, lines 51-54; and FIG. 6. Thus, the local microprocessor of the McGlone patent is configured with configuration data already contained within the slot reel peripheral. It is not configured with configuration data sent from the machine's master gaming controller 500.

By containing such information within the slot reel peripheral, the McGlone patent states that the amount of information needed to be installed on the master gaming controller may be minimized when the slot reel peripheral is replaced. *See* the McGlone patent at col. 10, lines 4-19 and col. 13, lines 55-57. Reducing the amount of information installed on the master gaming controller is a touted advantage of the McGlone patent. *See* the McGlone patent at col. 10, lines 4-19. If the McGlone patent were modified to configure the local microprocessor with configuration data sent from the master gaming controller, the configuration data would need to be installed on the master gaming controller. This would directly compromise McGlone's stated objective of minimizing the amount of information installed on the master gaming controller. This is improper because the proposed modification cannot render the prior art "unsatisfactory for its intended purpose." *See* M.P.E.P. § 2143.01. And the proposed modification cannot "change the principle of operation" of a reference. *Id.*

The final rejection of the office action mailed December 20, 2003 (Appendix D) ignores these express teachings of the McGlone patent and makes the conclusory statement that the

Applicant's claims would be obvious to ordinary skill in the art: "The suggestion [in the McGlone patent] that the peripheral (*i.e.*, local) controller may have non-volatile memory for storing configuration data provides a strong suggestion that the opposite may also be true." *See* December 20, 2003 Office Action at page 3. The Applicant respectfully submits that this suggesting-by-explicitly-disclosing-the-opposite reasoning is misplaced and is unsupported by the law of obviousness.

The law of obviousness requires that a reference be considered as a whole, including those portions that teach away from the Applicant's claimed invention. *See W.L. Gore*, 721 F.3d at 1550-51, 220 U.S.P.Q. at ("The totality of a reference's teaching must be considered."); *see also* M.P.E.P. § 2141.02 (stating that prior art must be considered in its entirety including disclosures that teach away from the claims). Indicia of teaching away in a reference gives insight into the question of obviousness. *Monarch Knitting*, 139 F.3d at 885, 45 U.S.P.Q.2d at 1984.

As discussed above, the McGlone patent states that the slot reel peripheral's configuration "is stored" in a non-volatile memory 616 of the slot reel controller 534 and is loaded into the local microprocessor's volatile memory 608 from the non-volatile memory 618. *See* the McGlone patent at col. 15, lines 25-57; col. 13, lines 51-54; and FIG. 6. The express teachings of the McGlone patent—teachings that teach away the Applicant's claims 1-5, 7-23, and 27—must not be ignored. Again, a main purpose of the reel peripheral of the McGlone patent is to provide a reel mechanism that can simply be plugged into a slot machine such that the master gaming controller is not bogged down with the tasks of configuring the reel mechanism components.

B. Device Drivers Are Not Configuration Data

The final rejection also attempts to make an obviousness case—in contrast to the above-discussed argument set forth in the final rejection—based on the storing of drivers in a memory of the master gaming controller:

McGlone also teaches that the master gaming controller includes a memory storing software for device drivers for at least some of the slot reel peripherals. (Col 3, 35-41) These device drivers are configuration data and are sent to the local microprocessor for configuring it to a reel spinning game conducted with a slot machine.

See December 20, 2003 Office Action at page 2. The Applicant strongly disagrees with this characterization of the McGlone patent. *Software device drivers cannot be equated with configuration data.* A device driver is a program that controls a device, such as a printer, disk drive, or keyboard. Many drivers, such as the keyboard driver, for example, come with an operating system. For other devices, a new driver may need to be loaded when connecting a new device to a computer. A driver acts like a translator between the device and programs that use the device. Each device has its own set of specialized commands that only its driver knows. Most programs, however, access devices by using generic commands. The driver, therefore, accepts generic commands from a program and then translates them into specialized commands for the device. See <http://www.webopedia.com/TERM/d/driver.html> (Appendix G). In sharp contrast, *configuration data are distinct pieces of information and are different from programs such as device drivers.* Programs are collections of instructions for manipulating data. See <http://www.webopedia.com/TERM/d/data.html> (Appendix H). Examples of configuration data include the type of slot machine, number of symbols on a reel, number of steps per revolution of a stepper motor, number of pulses per step, etc.

In the Advisory Action (Appendix E), the Examiner responds by reducing programs to data. The Applicant respectfully submits that this construction is incorrect. “Absent an express intent to impart a novel meaning, ‘terms in a claim are to be given their ordinary and accustomed meaning.’” *Tate Access Floors, Inc. v. Maxcess Techs., Inc.*, 222 F.3d 958, 965, 55 U.S.P.Q.2d 1513, 1517 (Fed. Cir. 2000) (quoting *Renishaw PLC v. Marposs Societa' Per Azioni*, 158 F.3d 1243, 1249, 48 U.S.P.Q.2d 1117, 1121 (Fed. Cir. 1998)). As evidenced by the McGlone patent itself, the Applicant is using these different terms consistent with their respective ordinary meanings. The McGlone patent explicitly states that the non-volatile memory of the peripheral controller may store “the configuration parameters needed to drive the slot reel using the drive mechanism including a moment of inertia of the slot reel, the size of the slot reel and one or more acceleration parameters” and that “the master gaming controller includes a memory storing software for . . . drivers.” See the McGlone patent at col. 3, lines 20-24 and 34-41. Thus, the Applicant respectfully submits that device drivers are not configuration data and that a rejection based on such reasoning is improper. The McGlone patent does not disclose, teach, or suggest a

CPU that sends configuration data to the local microcontroller for configuring the local microcontroller to a reel spinning game conducted with the slot machine.

C. The Alleged Motivation for Modifying the McGlone Patent—Elimination of Unnecessary Duplication of Parts—Set Forth in the Office Action Does Not Exist

The Examiner asserts as set forth below that the proposed modification will result in the elimination of unnecessary duplication of parts. It will not. The office action reads:

McGlone teaches that, “The peripheral controller may have a non-volatile memory arranged to store configuration parameters specific to the slot reel peripheral and state history information of the slot reel peripheral. In one embodiment, the non-volatile memory might be used to store the configuration parameters needed to drive the slot reel using the drive mechanism including a moment of inertia of the slot reel, the size of the slot reel and one or more acceleration parameters.” (Col 3, 17-24) The suggestion that the peripheral (i.e., local) controller may have non-volatile memory for storing configuration data provides a strong suggestion that the opposite may also be true. If the peripheral controller does not have non-volatile memory for storing configuration data, that data must be loaded to the peripheral controller from the central processing unit. Doing this would eliminate unnecessary duplication of parts because the data could be stored in one set of non-volatile memory instead of on non-volatile memory associated with each peripheral controller. This would reduce the cost of the gaming machine.

See December 20, 2002 Office Action at 2-3.

The Applicant strongly disagrees. First, if McGlone were modified to load configuration data to the peripheral controller from the CPU instead of from a non-volatile memory in the peripheral controller, one would not eliminate unnecessary duplication of parts. The McGlone patent’s peripheral controller would still require memory for receiving the configuration data from the CPU. The peripheral controller would also still require memory for other items such as the software program containing the low-level instructions executed by the peripheral controller. *See e.g.*, the McGlone patent at col. 15, lines 17-19 and FIG. 6. (“The control microprocessor [of the slot reel controller] will load software stored in its fixed memory.”)

Second, even if the peripheral controller required less non-volatile memory, any cost savings would be quite negligible. Accordingly, it would not have been obvious to modify McGlone to have its CPU send configuration data to the local microcontroller. Any conclusion to the contrary is based on hindsight using the Applicant’s own teachings. Obviousness cannot

“be established using hindsight or in view of the teachings or suggestions of the invention.” *Ex parte Maguire*, 2002 WL 1801466, *4 (Appendix F) (quoting *Para-Ordinance*, 73 F.3d at 1087, 37 U.S.P.Q.2d at 1239 (Fed. Cir. 1995), *cert. denied*, 519 U.S. 822 (1996)). It is the Applicant, not McGlone, that teaches that configuration data is loaded to the reel controller from the CPU. The Examiner’s asserted motivations, *i.e.* eliminating unnecessary duplication of parts and reducing costs, for modifying McGlone do not exist.

In the Advisory Action (Appendix E), the Examiner responded that the Applicant’s argument—that the proposed modification would not result in the elimination of unnecessary duplication of parts and reducing costs—is opinion and not evidence. If the McGlone reference were modified to send configuration data from the master gaming controller to the peripheral controller—a modification that the McGlone reference teaches away from—the data received by the peripheral controller would necessarily be stored in a memory specific to the reel controller.

Thus, the Applicant respectfully submits that claims 1-5, 7-23, and 27 are patentable over the McGlone patent under 35 U.S.C. § 103(a) because the McGlone patent does not disclose, teach, or suggest the subject matter of the Applicant’s claims 1-5, 7-23, and 27.

III. Claims 15, 17, 19, and 22 Are Patentable Over the McGlone Patent Under 35 U.S.C. § 103

Claims 15, 17, 19 and 22 further require that *in response to the configuration data, the local microcontroller processes the configuration data and reports a status of configuration of the local microcontroller back to the CPU*. The Examiner contends that “[i]t would have been obvious . . . [for McGlone] to have communicated the status of configuration from the local processor to the CPU . . . in order to prevent the game machine from operating in a misconfigured condition that would lead to errors in the game.” *See* December 20, 2003 Office Action at pages 4-5. First, the above contention incorrectly assumes that McGlone suggests transmission of configuration data by the CPU to the local microcontroller and processing of that data by the local microcontroller. As discussed above, the Applicant respectfully traverses this characterization of the McGlone patent.

Second, The Applicant respectfully submits that the Examiner has not established a *prima facie* case of obviousness. “To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” *See* M.P.E.P. § 2143.03. Put

simply, obviousness requires a teaching or suggestion by the prior art. The Examiner admits that the McGlone patent does not teach or suggest a *local microcontroller that processes configuration data and reports a status of configuration of the local microcontroller back to the CPU*: “[The] McGlone [patent] fails to specifically teach communication of the status of configuration from the local processor to the CPU.” See December 20, 2002 Office Action at page 4-5. Thus, because the Examiner admits that the McGlone patent does not teach the Applicant’s claims, the Examiner cannot reach the conclusion that Applicant’s claims are obvious in view of the McGlone. In short, a *prima facie* case of obviousness has not be made. Thus, the Applicant respectfully submits that claims 15, 17, 19, and 22 are patentable over the McGlone patent under 35 U.S.C. § 103(a).

IV. Claims 23 and 27 Are Patentable Over the McGlone Patent Under 35 U.S.C. § 103

In addition to the above-discussed sending-configuration-data limitation, claims 23 and 27 further require *determining the type of an encoder* (used for indicating reel position) *with the reel controller* and *using the reel controller to compare the determined type of the encoder with the configuration data*. The Applicant respectfully submits that the alleged motivation to modify the McGlone patent to meet this limitation does not exist, and that this limitation is not taught, suggested, or disclosed by the McGlone patent.

A *prima facie* case of obviousness requires, *inter alia*, (a) “some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference . . .,” and (b) that “the prior art reference . . . must teach or suggest all the claim limitations.” See M.P.E.P. § 2143.

The Examiner states “[i]n order to determine which of the various device drivers to download, it would be necessary for the [McGlone] reel controller to determine the type of encoder present and to report it to the CPU.” See December 20, 2002 Office Action at page 5. The McGlone patent teaches, however, that it is not necessary for the reel peripheral to determine type of encoder:

The configuration of the peripheral controller 534, which includes information about the types of peripheral devices [including the position sensors 410] controlled by the peripheral controller 534, is stored in a non-volatile memory 616. When the peripheral devices on a slot reel peripheral are changed, the non-

volatile memory 616 can be replaced or reprogrammed to incorporate the new configuration.

See the McGlone patent at col. 13, lines 51-57. There is no need for the peripheral (reel) controller 534 to determine the type of position sensors 410 used to determine the reel position because that information is already known to the peripheral (reel) controller 534 because it is stored in the peripheral controller's memory 616. Thus, the alleged motivation for modifying the McGlone patent—the necessity to determine the type of encoder to determine which of the various device drivers to download —does not exist because the type of encoder is already known to the McGlone reel controller 534, which obviates the need to determine the same information. There is simply no motivation to one of ordinary skill in the art to modify the McGlone patent as suggested in the office action.

Further, the McGlone patent does not disclose, teach, or suggest determining the type of encoder (used for indicating reel position) with the reel controller and using the reel controller to compare the determined type of the encoder with the configuration data. Again, the McGlone patent discloses that type of position sensor is stored in a memory of the reel peripheral. *Id.* Therefore, the Applicant respectfully submits that claims 23 and 27 are patentable over the McGlone patent under 35 U.S.C. § 103(a).

V. Claim 28 Is Patentable Over the McGlone Patent Under 35 U.S.C. § 103

Claim 28 is patentable over the McGlone patent under 35 U.S.C. § 103(a) because the McGlone patent does not disclose, teach, or suggest the subject matter of the Applicant's claims.

Independent claim 28 requires *determining the type of the encoder with the reel controller by causing a motor to spin the reel and detecting a physical characteristic of the encoder*. Initially, as addressed above with respect to claims 23 and 27, the Applicant respectfully submits that the McGlone patent does not disclose, teach, or suggest *determining the type of the encoder*. Specifically regarding claims 28, the Examiner asserts:

The easiest way to determine the type of encoder present would be to cause the motor to spin and count the number of flags on the encoder. Thus it would have been obvious . . . to have caused the motor to spin the reel and detect the physical characteristic (i.e., the number of flags) of the encoder in order to determine which type of encoder was present, thus enabling the loading of the correct device driver.

McGlone, however, explicitly teaches that its master gaming controller would be able to identify the type of peripheral device and its features from a series of numbers. *See* the McGlone patent at col. 18, lines 5-7. As an example, McGlone teaches that combinations of the device class, manufacturer, device protocol and serial number information from a particular device may be used. *See* the McGlone patent at col. 18, lines 2-4. McGlone says nothing whatsoever about determining the type of encoder with the reel controller by causing a motor to spin the reel and detecting a physical characteristic of the encoder. Clearly, McGlone must not believe that this is the “easiest way” to determine the type of encoder. Assuming *arguendo* that the “easiest way” to determine the type of encoder is by causing a motor to spin the reel and detecting a physical characteristic of the encoder, the mere fact that McGlone clearly teaches a different way would lead an ordinary artisan away from the claimed invention. *See* M.P.E.P. § 2141.02 (stating that prior art must be considered in its entirety, including disclosures that teach away from the claims). Thus, to modify the McGlone patent as suggested would change its principle of operation. *See* MPEP 2143.01.

The Advisory Action contends the Applicant does not fully understand the law of obviousness: “Applicant is under a misconception concerning the meaning of ‘teaches away.’ When a reference ‘teaches way’ from a concept, it teaches that the concept does not work.” *See* March 7, 2003 Advisory Action at 2 (emphasis added). The Applicant respectfully submits that this statement is in error, and that the proper standard is not so exacting:

A prior art reference may be considered to teach away when “a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.”

Monarch Knitting, 139 F.3d at 885, 45 U.S.P.Q.2d at 1984 (quoting *In re Gurley*, 27 F.3d at 553, 31 U.S.P.Q. at 1131. Clearly, the McGlone patent leads an artisan of ordinary skill away from the Applicant’s invention by teaching that the McGlone master gaming controller would be able to identify the type of peripheral device and its features from a series of numbers. *See* the McGlone patent at col. 18, lines 5-7. Thus, the Applicant’s respectfully submit that claims 23, 27, and 28 are patentable over the McGlone patent under 35 U.S.C. § 103(a).

VI. Claim 29 Is Patentable Over the McGlone Patent in View of the Sakamoto Patent Under 35 U.S.C. § 103

Claim 29 was rejected under 35 U.S.C. § 103(a) as being unpatentable over McGlone in view of U.S. Patent No. 6,315,663 to Sakamoto. Claim 29 requires that *the CPU issues a high-level command to the reel controller for informing the reel controller of an acceleration or deceleration profile*. This feature is advantageous because it reduces the processing burden of the CPU and frees up the CPU for other tasks. The Examiner acknowledges that McGlone “does not teach an acceleration or deceleration profile for accelerating or deceleration the reel.” Instead, the Examiner relies upon Sakamoto for this teaching, saying that “[i]t would have been obvious . . . to have the CPU send high-level commands concerning acceleration or deceleration profile for accelerating or decelerating the reel to the reel controller in order to add visual interest to the slot machine game.”

Further, the Applicant respectfully submits that the combination of McGlone and Sakamoto is improper because McGlone clearly teaches away from the combination. *See* M.P.E.P. § 2145(X)(D)(2) (“It is improper to combine references where the references teach away from their combination.”) Specifically, McGlone discloses that a table of motor step rates is stored in a memory of either the master gaming controller or the slot reel controller, depending upon which controller controls the reel’s stepper motor. *See* the McGlone patent at col. 9, lines 1-11 and 23-57. When the slot reel controller is used, McGlone’s table of step rates resides in the slot reel controller and is not transferred from the master gaming controller to the slot reel controller:

Further, the maintenance required to replace a slot reel might be reduced when a slot reel peripheral is used. For example, the table of step rates is usually required to drive the stepper motor for a particular slot reel. When a new slot reel is installed on a gaming machine and the master gaming controller drives the stepper motor of the slot reel, a table to drive the stepper motor corresponding to the new slot reel may be loaded into a memory device on the mother board containing the master gaming controller. Further, all the low-level commands and software needed to drive the stepper motor may also be loaded in memory on the motherboard. This process may be very time consuming. Using the slot reel peripheral, most of this information may be contained within the slot reel controller. Thus, the amount of information need to be installed on the master gaming controller may be minimized when the slot reel peripheral is replaced.

See the McGlone patent at col. 10, lines 4-19.

In an example, the McGlone patent teaches that the step rates are included in a low-level command issued by the slot reel controller, not a high-level command sent from the master gaming controller to the slot reel controller:

For the stepper motor example described above, the low-level commands, charge the motor, initiate first step, step at rate 1, step at rate 2, step at rate 3, step at rate 4, perform final step, and stop the motor, might be initiated by the slot reel controller 402 after receiving a high-level instruction from the master gaming controller 422 like “move the slot reel 420 to position A.”

See the McGlone patent at col. 9, lines 51-57.

To modify McGlone based on Sakamoto would change the principle operation of the McGlone patent. *See* M.P.E.P. § 2143.01 (stating that the proposed modification cannot change the principle of operation of the reference). Accordingly, the rejection of claim 29 should be withdrawn. The Applicant respectfully submits that claims 29 is patentable over the McGlone patent in view of the Sakamoto under 35 U.S.C. § 103(a).

9. CONCLUSION


For at least the foregoing reasons, the final rejection of all the appealed claims -- claims 1-5, and 7-23, 27-28, and 29 -- set forth in the Office Action mailed December 20, 2002 should be reversed.

In accordance with 37 C.F.R. § 1.192(a), the Applicant is submitting this brief in triplicate.

A check in the amount of \$430.00 is enclosed herewith as required by 37 C.F.R. § 1.17(c) for filing this Appeal Brief and for the Petition for Extension of Time filed herewith. The Commissioner is authorized to charge any additional fees inadvertently omitted that may be required (except the issue fee) now or during the pendency of this application to JENKENS & GILCHRIST, P.C. Deposit Account No. 10-0447(47079-00058).

Respectfully submitted,

Date: June 23, 2003



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ATTORNEYS FOR APPLICANT

APPENDIX A
APPEALED CLAIMS 1-5, 7-23, and 27-29

1. A slot machine, comprising:
a central processing unit for operating the slot machine in response to a wager; and
a reel mechanism including a motor, a symbol-bearing reel, and a reel driver, said motor including a rotatable shaft, said reel being mounted to said shaft, said reel driver including a local microcontroller distinct from and coupled to said central processing unit, said reel driver being coupled to said motor to cause said motor to rotate said reel, said local microcontroller performing low-level reel driver operations independent from said central processing unit;
wherein said central processing unit sends configuration data to said local microcontroller for configuring said local microcontroller to a reel spinning game conducted with the slot machine.
2. The slot machine of claim 1, wherein in response to actuation by a player, said reel is rotated and stopped to place the symbols of said reel in visual association with one or more pay lines.
3. The slot machine of claim 1, wherein said low-level reel driver operations include monitoring said reel and at least partially controlling its position.
4. The slot machine of claim 3, wherein said local microcontroller monitors said reel by sampling its state multiple times per second in real time, and responds with control commands for controlling the position of said reel.
5. The slot machine of claim 1, wherein said local microcontroller is serially connected to said central processing unit.
7. The slot machine of claim 1, wherein said central processing unit issues high-level commands to said local microcontroller, said high-level commands including a start spin

command for spinning said reel and a stop command for stopping said reel at a specified stop position.

8. The slot machine of claim 1, wherein said reel includes an encoder for indicating the position of said reel, and wherein said reel driver includes an optical detector for reading said encoder, said local microcontroller being coupled to said optical detector to monitor the position of said reel.

9. A slot machine, comprising:
a motor including a rotatable shaft;
a symbol-bearing reel mounted to said shaft;
a reel driver including a local microcontroller serially linked to said central processing unit, said reel driver being coupled to said motor to cause said motor to rotate said reel, said local microcontroller performing low-level reel driver operations related to rotation of said reel; and
a central processing unit issuing high-level commands to said reel driver related to the rotation of said reel;
wherein said central processing unit sends configuration data to said local microcontroller for configuring said local microcontroller to a reel spinning game conducted with the slot machine.

10. The slot machine of claim 9, wherein said high-level commands include a start spin command and a stop command, said start spin command instructing said reel driver to cause said motor to rotate said reel, said stop command instructing said reel driver to stop said motor from rotating said reel at a specified stop position

11. The slot machine of claim 10, wherein said low-level commands include sampling a state of said reel in real time and at least partially controlling its position.

12. A slot machine, comprising:
a motor including a rotatable shaft;
a symbol-bearing reel mounted to said shaft;
a reel driver including a local microcontroller, said reel driver being coupled to said motor to cause said motor to rotate said reel; and
a central processing unit for issuing a start spin command and a stop command to said reel driver, said start spin command instructing said reel driver to cause said motor to rotate said reel, said stop command instructing said reel driver to stop said motor from rotating said reel at a specified stop position;
said local microcontroller monitoring said reel in real time and at least partially controlling its position after said start spin command and prior to said stop command;
wherein said central processing unit sends configuration data to said local microcontroller for configuring said local microcontroller to a reel spinning game conducted with the slot machine.

13. The slot machine of claim 12, wherein said reel includes an encoder for indicating the position of said reel, and wherein said reel driver includes an optical detector for reading said encoder, said local microcontroller being coupled to said optical detector to monitor the position of said reel in real time.

14. The slot machine of claim 1, wherein said configuration data includes at least one of the type of slot machine, a number of symbols on said reel, how to drive said motor, and a number of steps in said motor if said motor is a stepper motor.

15. The slot machine of claim 1, wherein in response to receiving said configuration data, said local microcontroller processes said configuration data and reports a status of configuration of said local microcontroller back to said central processing unit.

16. The slot machine of claim 9, wherein said configuration data includes at least one of the type of slot machine, a number of symbols on said reel, how to drive said motor, and a number of steps in said motor if said motor is a stepper motor.

17. The slot machine of claim 9, wherein in response to receiving said configuration data, said local microcontroller processes said configuration data and reports a status of configuration of said local microcontroller back to said central processing unit.

18. The slot machine of claim 12, wherein said configuration data includes at least one of the type of slot machine, a number of symbols on said reel, how to drive said motor, and a number of steps in said motor if said motor is a stepper motor.

19. The slot machine of claim 12, wherein in response to receiving said configuration data, said local microcontroller processes said configuration data and reports a status of configuration of said local microcontroller back to said central processing unit.

20. A method of configuring a slot machine to a reel spinning game conducted with the machine, the method comprising:

providing a physical symbol-bearing reel;

providing a reel controller for performing low-level operations related to movement of said reel;

providing a central processing unit for issuing high-level commands to said reel controller related to the movement of said reel; and

sending configuration data from said central processing unit to said reel controller to configure said reel controller to the reel spinning game.

21. The method of claim 20, wherein said configuration data includes at least one of the type of slot machine, a number of symbols on said reel, how to drive said motor, and a number of steps in said motor if said motor is a stepper motor.

22. The method of claim 20, further including processing said configuration data with said reel controller and reporting a status of configuration of said reel controller back to said central processing unit.

23. A method of configuring a slot machine to a reel spinning game conducted with the machine, the method comprising:

providing a physical symbol-bearing reel including an encoder for indicating a position of said reel;

providing a reel controller for performing low-level operations related to movement of said reel;

providing a central processing unit for issuing high-level commands to said reel controller related to the movement of said reel;

sending a command from said central processing unit to said reel controller to determine a type of said encoder;

determining the type of said encoder with said reel controller;

sending configuration data from said central processing unit to said reel controller to configure said reel controller to the reel spinning game; and

using said reel controller to compare the determined type of said encoder with said configuration data.

27. The method of claim 23, further including reporting an error back to said central processing unit if the determined type of said encoder conflicts with said configuration data.

28. A method of configuring a slot machine to a reel spinning game conducted with the machine, the method comprising:

providing a physical symbol-bearing reel including an encoder for indicating a position of said reel;

providing a reel controller for performing low-level operations related to movement of said reel;

providing a central processing unit for issuing high-level commands to said reel controller related to the movement of said reel;

sending a command from said central processing unit to said reel controller to determine a type of said encoder; and

determining the type of said encoder with said reel controller, which includes causing a motor to spin said reel and detecting a physical characteristic of said encoder.

29. A method of configuring a slot machine to a reel spinning game conducted with the machine, the method comprising:

providing a physical symbol-bearing reel;

providing a reel controller for performing low-level operations related to movement of said reel; and

providing a central processing unit for issuing high-level commands to said reel controller related to the movement of said reel, said high-level commands including a command for informing said reel controller of at least one of an acceleration profile for accelerating said reel and a deceleration profile for decelerating said reel.



US006394900B1

(12) **United States Patent**
McGlone et al.

(10) **Patent No.:** **US 6,394,900 B1**
(45) Date of Patent: **May 28, 2002**

- (54) **SLOT REEL PERIPHERAL DEVICE WITH A PERIPHERAL CONTROLLER THEREIN**
- (75) **Inventors:** James T. McGlone; Steven G. LeMay; Wesley F. Carmean, all of Reno, NV (US)
- (73) **Assignee:** International Game Technology, Reno, NV (US)
- (*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
- (21) **Appl. No.:** 09/478,269
- (22) **Filed:** Jan. 5, 2000
- (51) **Int. Cl.⁷** A63F 13/00
- (52) **U.S. Cl.** 463/20; 463/16; 463/21; 463/22; 463/47; 273/142 R
- (58) **Field of Search** 463/1, 16, 20, 463/21, 42, 43, 46, 47, 22; 273/138.1, 138.2, 139, 143 G, 142 R

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Primary Examiner—Jessica J. Harrison

Assistant Examiner—John M Hotaling, II

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(57) **ABSTRACT**

A disclosed slot reel peripheral has a slot reel, a drive mechanism and a peripheral controller. Using a standard communication protocol such as USB (Universal Serial Bus), the peripheral controller is configured to communicate with one or more master gaming controllers or other slot reel peripherals via a peripheral connection. The peripheral controller may drive the slot reel from position to position by operating the drive mechanism and may send operating instructions to other slot reel peripherals with peripheral controllers. Further, the peripheral controller may control one or more specialized "peripheral devices" (e.g., effects lights, back lights, bar code detectors, tampering sensors, position sensors, sound devices, electro-luminescent devices and stepper motors, etc. that perform specific functions of the slot reel peripheral).

32 Claims, 9 Drawing Sheets

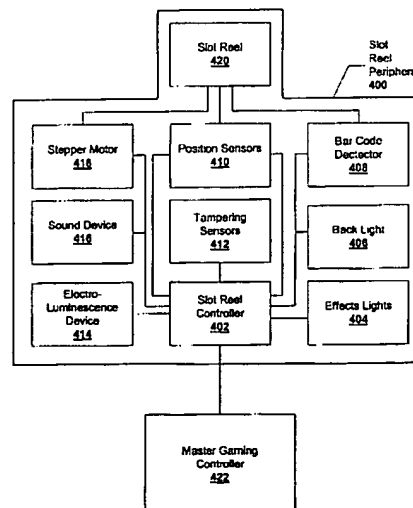
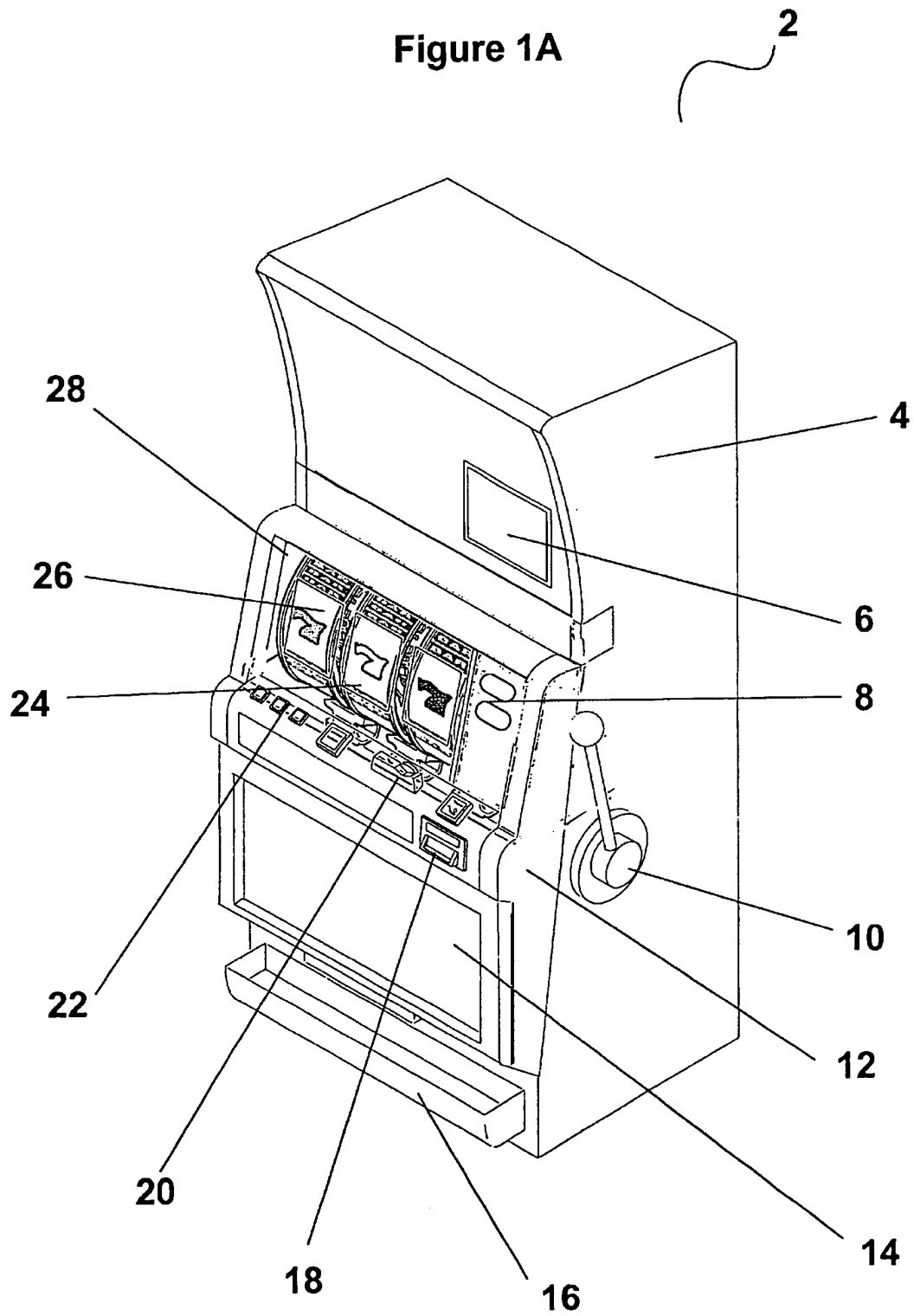


Figure 1A



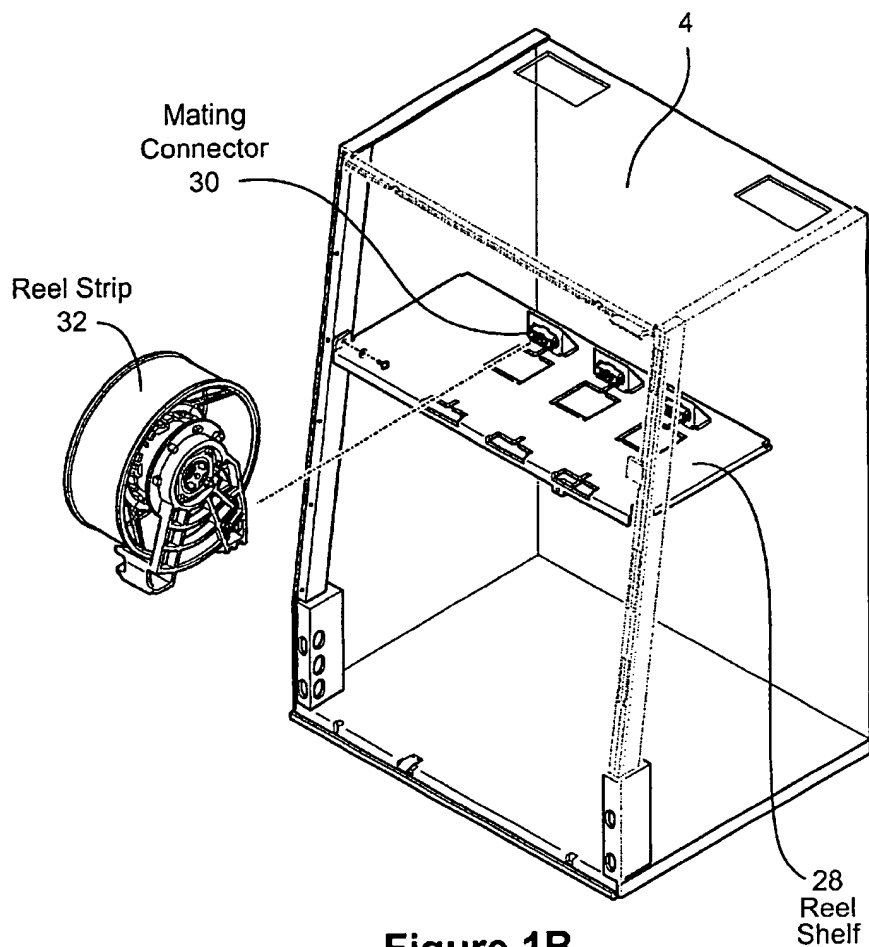


Figure 1B

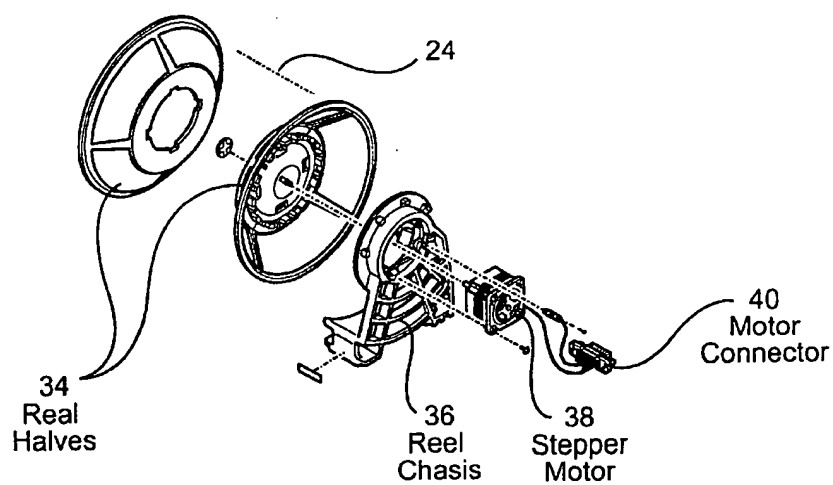


Figure 1C

Figure 2

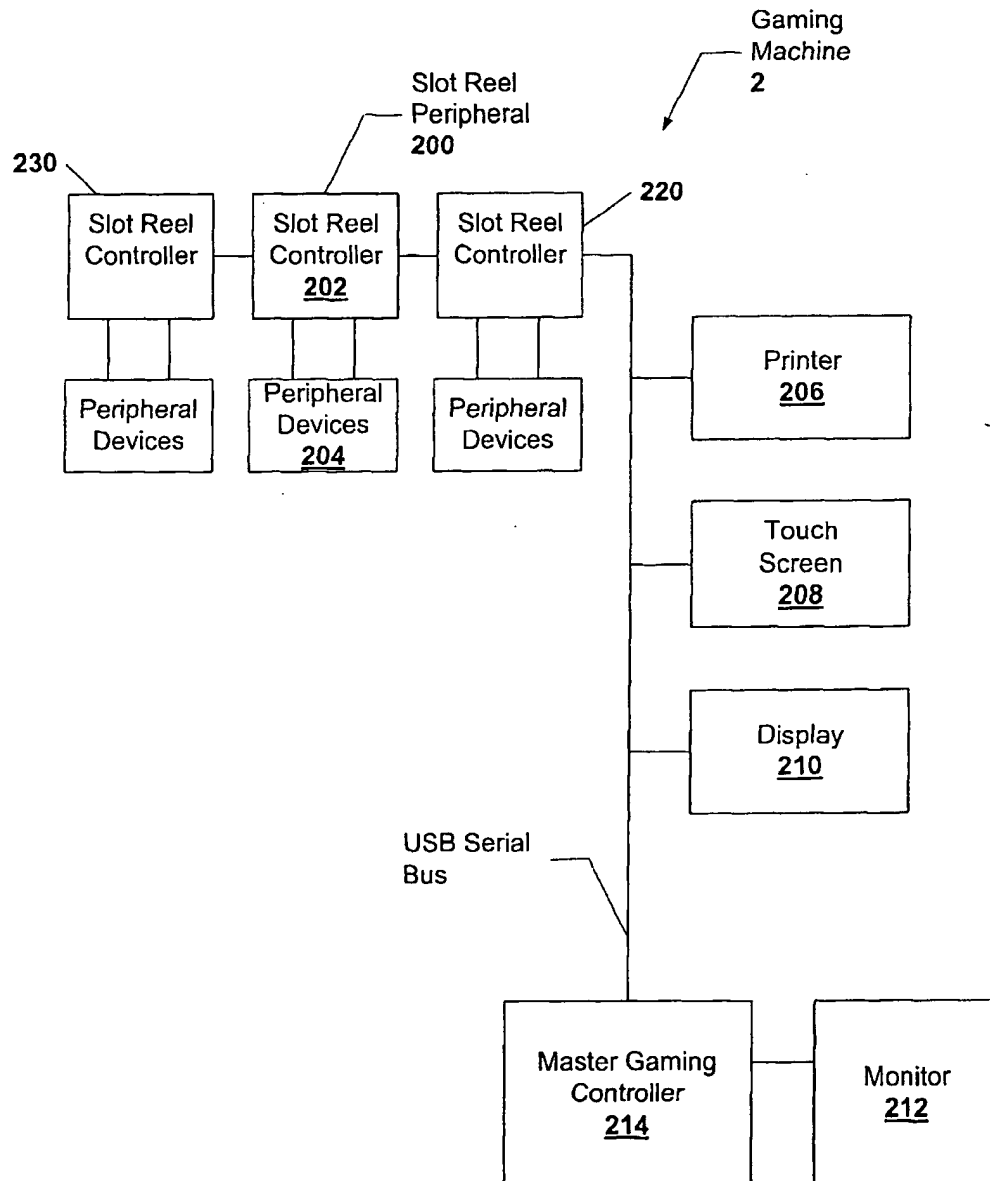


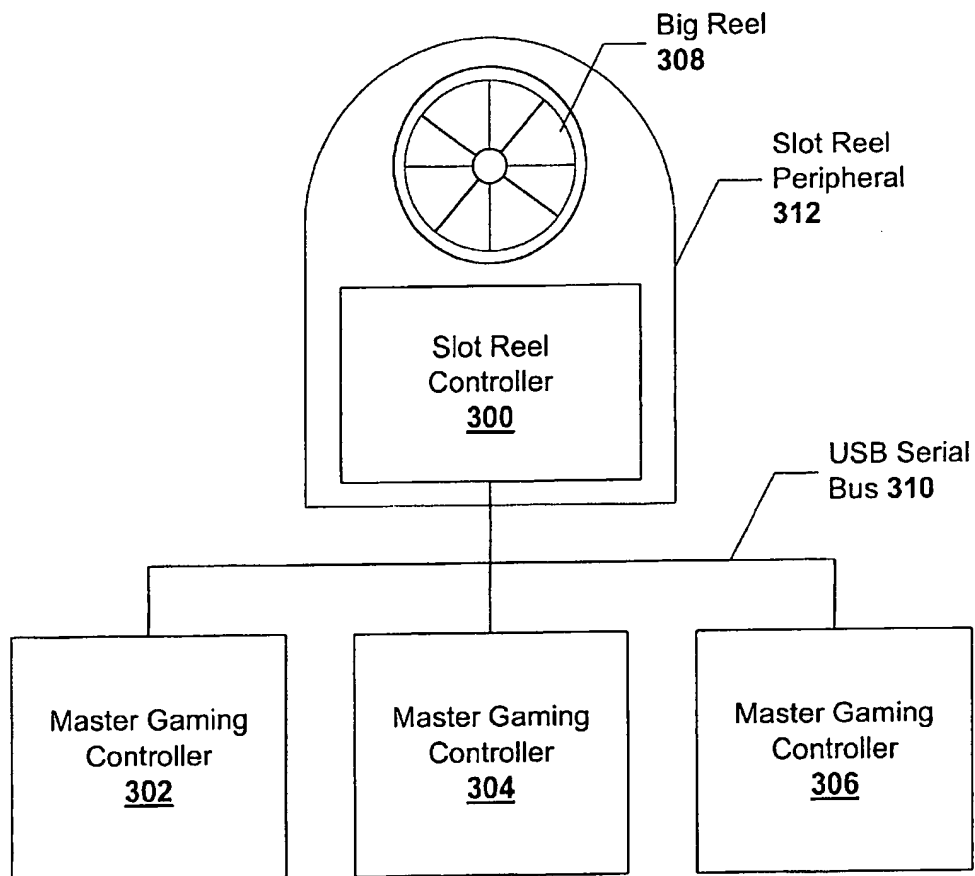
Figure 3

Figure 4

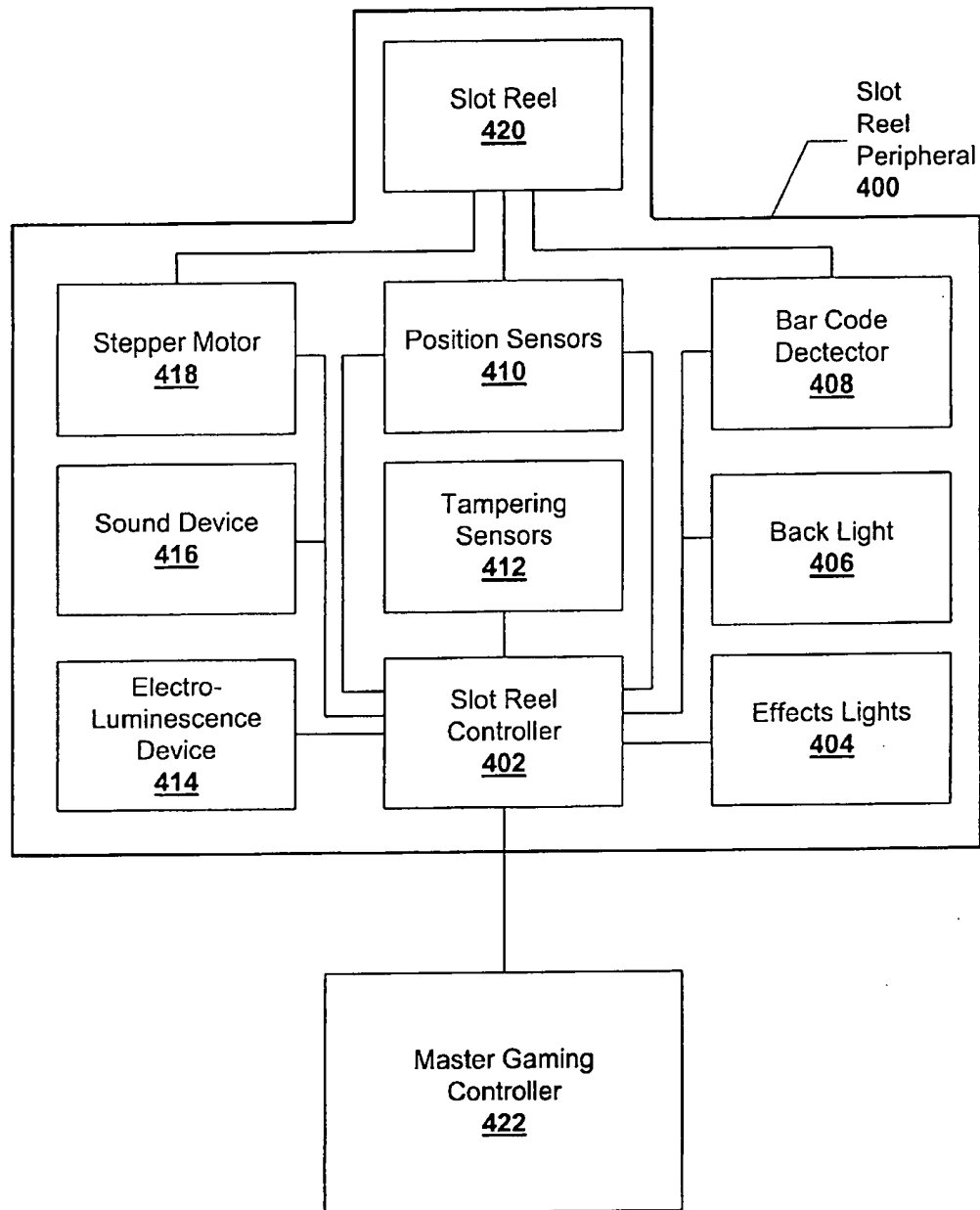


Figure 5

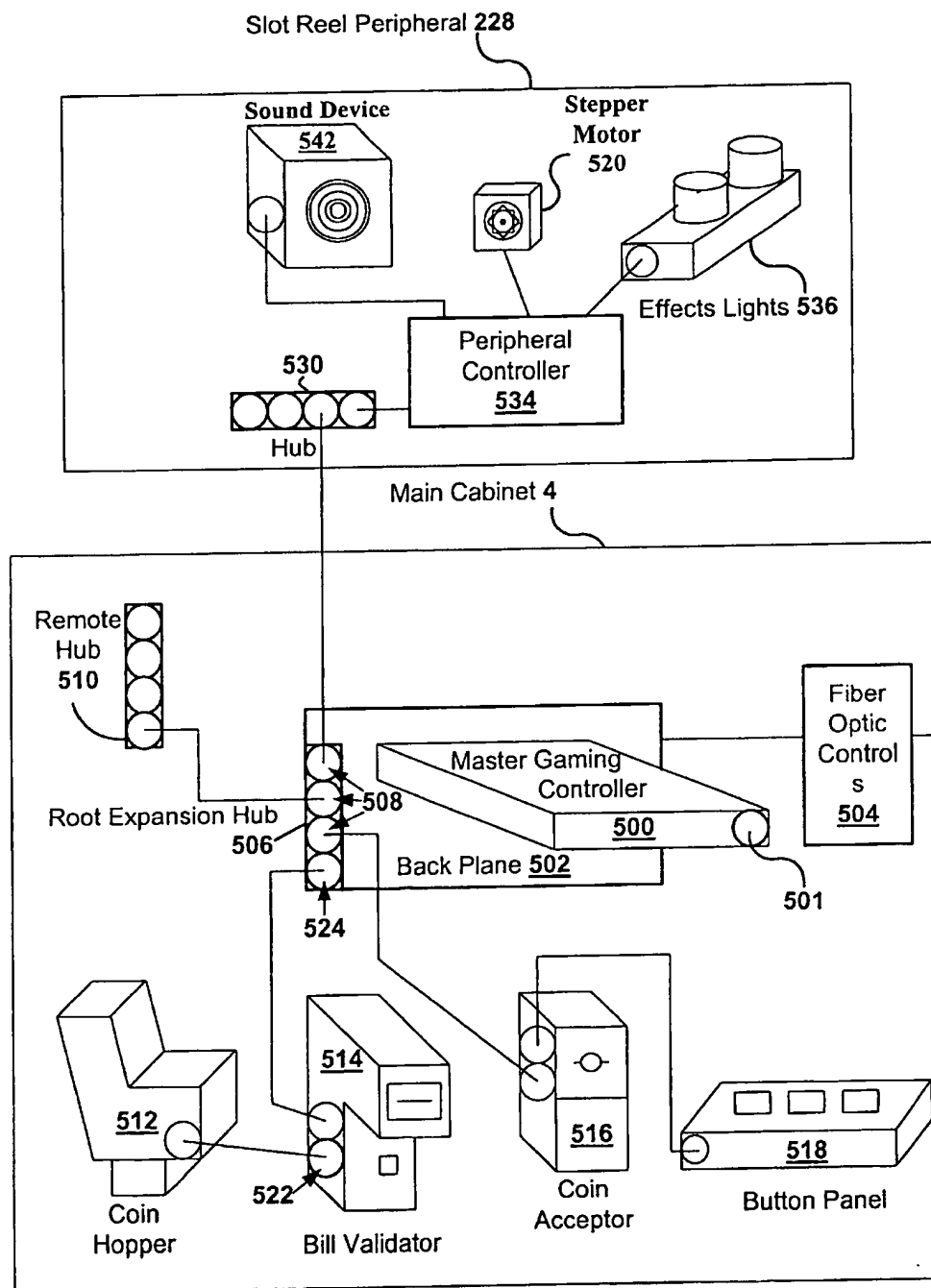


Figure 6

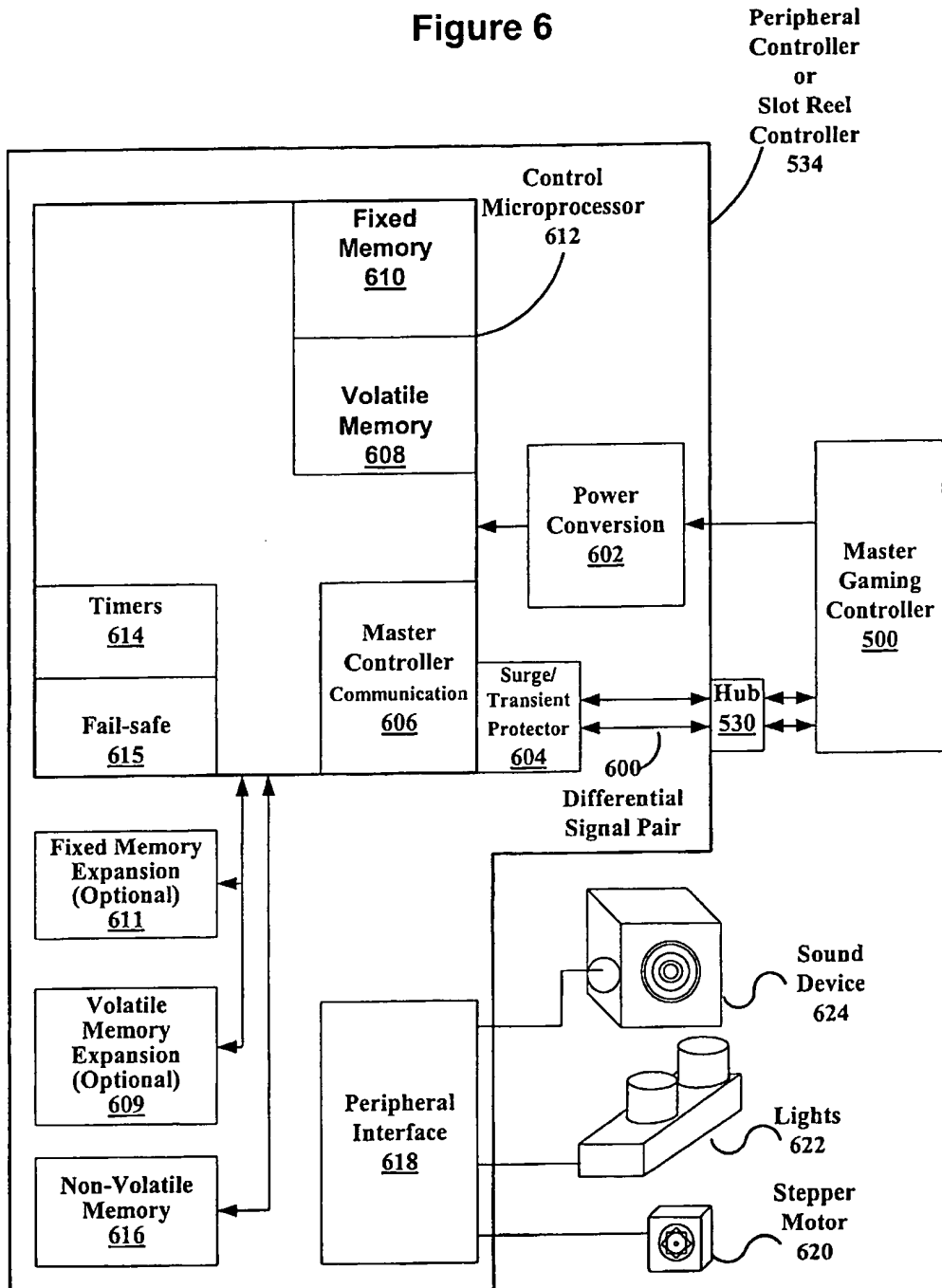


Figure 7

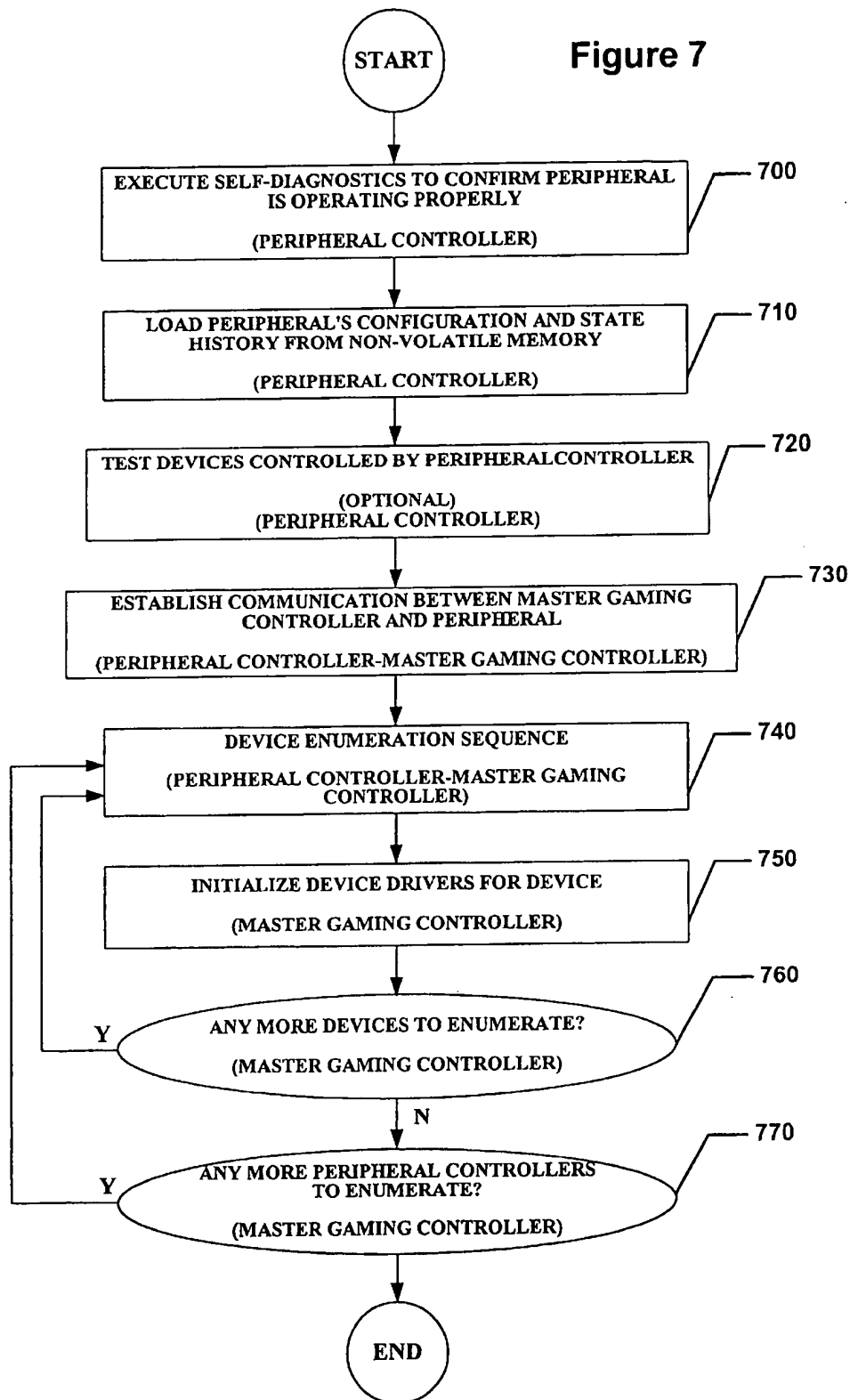
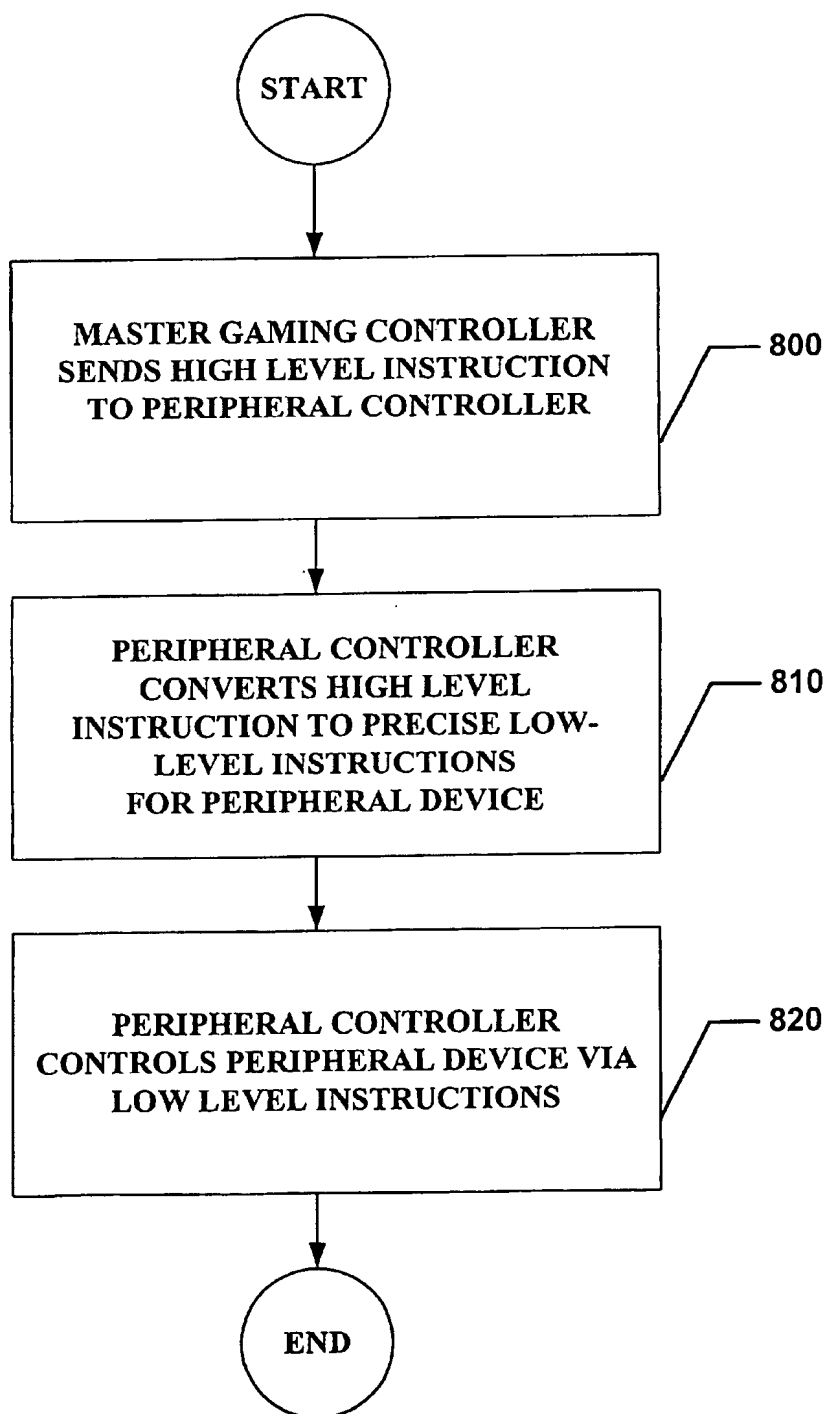


Figure 8

SLOT REEL PERIPHERAL DEVICE WITH A PERIPHERAL CONTROLLER THEREIN

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to U.S. patent application Ser. No. 09/414,659 filed on Oct. 6, 1999, naming Stockdale and LeMay as inventors and titled "STANDARD PERIPHERAL COMMUNICATION."

BACKGROUND OF THE INVENTION

This invention relates to gaming peripherals for gaming machines such as slot machines. More particularly, the present invention relates to slot reels as gaming peripherals for gaming machines.

There are a wide variety of associated devices that can be connected to or serve as part of a gaming machine such as a slot machine. These devices provide gaming features that define or augment the game(s) played on the gaming machine. Some examples of these devices are slot reels, lights, ticket printers, card readers, speakers, bill validators, coin acceptors, display panels, key pads, and button pads. Many of these devices are built into the gaming machine. Often, a number of devices are grouped together in a separate box that is placed on top of the gaming machine. Devices of this type are commonly called a top box.

Typically, the gaming machine controls various combinations of devices. The features of a given device, including slot reels, are usually controlled by a "master gaming controller" within the gaming machine. For example to control a slot reel during a game, the master gaming controller might perform many different operations including instructing a stepper motor on the slot reel to spin and then stop at a certain position, instructing lights on the slot reel to go on and off in various patterns, or instructing a speaker connected to the slot reel to emit various sound patterns. For the master gaming controller to perform these operations, connections from the slot reel are wired directly into some type of electronic board (e.g., a "back plane" or "mother board") containing the master gaming controller.

The components of a slot reel might include a reel of certain size, a reel strip indicating positions on the reel, a position sensor, a stepper motor, tampering sensors, a back light and an effects light. Parameters and operation features for each of these components must be known to the master gaming controller to operate a particular slot reel. The required information is incorporated into software and stored in some type of memory device on the master gaming controller. This slot reel specific software operates the features of the device during a game. Typically, the software is executed by a microprocessor located on the master gaming controller. As an example, to operate a slot reel, the development of the software for the master gaming controller may consider information such as the moment of inertia of the slot reel, the number of positions on the reel strip, the type of stepper motor, features of the stepper motor, signals that correspond to each feature on the stepper motor, and the response time of the stepper motor.

Traditionally, the master gaming controller has performed all game functions including the calculation of the game outcome, coin handling, communications with external devices, lighting control, operation of the slot reels, etc. for the slot machine. As the slot machine has evolved, the features offered to players have become more complex and the potential combinations of gaming devices available to a gaming machine has increased. For example, video

animations, combined with digital audio have been added to the basic game play of the spinning reel slot machine. To execute these complex game features and perform all of the game functions, a microprocessor with significant computational capabilities is required. Further, to accommodate all of the gaming devices within the gaming machine, the motherboard containing the microprocessor must have the necessary circuitry and wiring needed to communicate with the all of the devices operated by the master gaming controller. In the past instead of designing one motherboard that could accommodate communications with all of the potential gaming devices, a number of different motherboards were designed, each accommodating communications with some subset of the available gaming devices.

Disadvantages of the current slot machine architecture include the following. First, the number of types of motherboards needed to accommodate all of the potential combinations of gaming devices has become large. Second, the computational capabilities of the motherboard needed to drive all the devices has become large. Third, when devices are added to augment the features of the gaming machine or when devices are replaced for maintenance the steps necessary to rewire the device onto the motherboard and load the appropriate software onto the motherboard can be time consuming and require significant shutdown time for the gaming machine. Accordingly, it would be desirable to provide slot reels that are compatible with a standard communication protocol and/or connection system for installing or removing devices controlled by a master gaming controller. A slot reel gaming peripheral that is compatible with a standard communication protocol and/or connection system may reduce the number of types of motherboards that are needed for the gaming machine and may reduce the amount of maintenance time when a slot reel is replaced. Further, it would be desirable to have the slot reel gaming peripheral control some of its own functions rather than having all the functions controlled by the master gaming controller. This feature might reduce the load on the computational resources of the master gaming controller.

SUMMARY OF THE INVENTION

This invention addresses the needs indicated above by providing a slot reel peripheral having a slot reel, a drive mechanism and a peripheral controller. Using a standard communication protocol such as USB (Universal Serial Bus), the peripheral controller is configured to communicate with one or more master gaming controllers or other slot reel peripherals via a peripheral connection. The peripheral controller may drive the slot reel from position to position by operating the drive mechanism and may send operating instructions to other slot reel peripherals with peripheral controllers. Further, the peripheral controller may control one or more specialized "peripheral devices" (e.g., effects lights, back lights, bar code detectors, tampering sensors, position sensors, sound devices, electro-luminescent devices and stepper motors, etc. that perform specific functions of the slot reel peripheral).

One aspect of the present invention provides a slot reel peripheral that generally can be characterized as including (1) a drive mechanism, (2) a single slot reel that may be moved from position to position by the drive mechanism, (3) a peripheral controller that directly controls the drive mechanism and (4) a peripheral communication connection for connecting the peripheral controller to a master gaming controller. The drive mechanism controlled by the peripheral controller may be a stepper motor. Further, the peripheral controller may control a number of peripheral devices

associated with the slot reel peripheral including effects lights, position sensors, bar code detectors, back lights, tampering sensors, sound devices and electro-luminescent devices. The peripheral controller may be connected to one or more of the peripheral devices via a peripheral interface. The peripheral controller includes a memory storing software for a communication protocol that allows communication with the peripheral devices via the peripheral interface.

In preferred embodiments, the peripheral controller includes a control microprocessor that controls communication over the peripheral communication connection. Also, the slot reel peripheral may include a hub comprising a number of peripheral communication connections. Through one or more of these peripheral connections the peripheral controller may communicate with other slot reel peripherals. The peripheral controller may have a non-volatile memory arranged to store configuration parameters specific to the slot reel peripheral and state history information of the slot reel peripheral. In one embodiment, the non-volatile memory might be used to store the configuration parameters needed to drive the slot reel using the drive mechanism including a moment of inertia of the slot reel, the size of the slot reel and one or more acceleration parameters.

Another aspect of the present invention provides a gaming machine that can generally be characterized as including (1) a master gaming controller that controls one or more games played on the gaming machine and (2) at least one slot reel peripheral. The slot reel peripheral should include (a) a drive mechanism, (b) a single slot reel that is moved from position to position by the drive mechanism, (c) a peripheral controller that directly controls the drive mechanism and (d) a peripheral communications connection connecting the peripheral controller to the master gaming controller. In preferred embodiments, the master gaming controller includes a memory storing software for (i) standard device identification protocol for at least some of the slot reel peripherals, (ii) device drivers for at least some of the slot reel peripherals and (iii) a communication protocol that allows communication with the slot reel peripherals via the peripheral communications connection. Further, the slot reel peripheral includes a memory storing software for a communication protocol that allows communication with the master gaming controller via the peripheral communication connection. As described above, the gaming machine may be a video slot machine.

In preferred embodiments, the slot reel peripheral may be configured to receive high-level instructions from the master gaming controller that do not specify precise control of the drive mechanism of the slot reel peripheral. Following the high-level instructions, the peripheral controller of the slot reel peripheral receiving the high-level instructions may provide low-level instructions precisely controlling the operation of its drive mechanism. Further, one slot reel peripheral may be configured to send high-level instructions that do not specify precise control of the drive mechanism to a second slot reel peripheral. Following the high-level instructions, the peripheral controller of the second slot reel peripheral receiving the high-level instructions may provide low-level instructions precisely controlling the operation of its drive mechanism.

Another aspect of the present invention provides a gaming machine network including a slot reel peripheral and a plurality of gaming machines. The slot reel peripheral should include a drive mechanism and a single slot reel that is moved from position to position by the drive mechanism. Each gaming machine should include a master gaming

controller that controls the slot reel peripheral and a peripheral communication connection configured to communicate with the slot reel peripheral. The slot reel peripheral may be configured to receive high-level instructions from the plurality of master gaming controllers that do not specify precise control of the drive mechanism of the slot reel peripheral. Following the high-level instructions, the peripheral controller of the slot reel peripheral may provide low-level instructions precisely controlling the operation of its drive mechanism.

Another aspect of the present invention provides a method for controlling operation of a slot reel peripheral containing a single slot reel on a gaming machine. The method may include the steps of (1) receiving a high level instruction for controlling the slot reel peripheral from a first master gaming controller via a standard peripheral connection to a peripheral controller associated with the slot reel peripheral where the high level instruction does not precisely specify how the slot reel peripheral must perform an operation associated with the high level instruction, (2) converting the high level instruction to one or more low level operating instructions, at the peripheral controller, for controlling the operation of one or more peripheral devices provided with the slot reel peripheral and (3) controlling operation of the one or more peripheral devices with the low level operating instructions. In the a preferred embodiment, the method may also include the steps of (a) storing state history information in the slot reel peripheral specifying a recent operating state of the slot reel peripheral and (b) transmitting the stored state history information to the first master gaming controller. In another embodiment the slot reel peripheral may receive a high level instruction for controlling the slot reel peripheral from a second slot reel peripheral via a standard peripheral connection or from a second master gaming controller different from the first master gaming controller.

These and other features of the present invention will be presented in more detail in the following detailed description of the invention and the associated figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a perspective drawing of a gaming machine having a set of slot reels and other devices.

FIG. 1B is a perspective drawing of a gaming machine cabinet and slot reel assembly.

FIG. 1C is an exploded perspective drawing of the interior parts of a slot reel assembly.

FIG. 2 is a block diagram depicting a slot reel gaming peripheral and its connection over a communication network to a master gaming controller in accordance with this invention.

FIG. 3 is a block diagram depicting a slot reel gaming peripheral and its connection over a communication network to a plurality of master gaming controllers in accordance with this invention.

FIG. 4 is a block diagram depicting a more detailed example of a slot reel peripheral in accordance with this invention.

FIG. 5 is a block diagram depicting a slot reel gaming peripheral and its connection to a master gaming controller in accordance with this invention.

FIG. 6 is a block diagram depicting a more detailed example of a slot reel gaming peripheral in accordance with this invention.

FIG. 7 is a flow diagram depicting the slot reel peripheral power-up and communication process with the master gaming controller.

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FIG. 8 is a flow diagram depicting the details of a general communication process of a slot reel peripheral device with a master gaming controller.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning first to FIG. 1A, a video gaming machine 2 of the present invention is shown. The gaming machine 2 includes a main cabinet 4, which generally surrounds the machine interior (not shown) and is viewable by users. The main cabinet includes a main door 12 on the front of the machine, which opens to provide access to the interior of the machine. Typically, the main door 12 and/or any other portals which provide access to the interior of the machine utilize a locking mechanism of some sort as a security feature to limit access to the interior of the gaming machine. Attached to the main door are player-input switches 22, a coin acceptor 20, and a bill validator 18, a coin tray 16, and a belly glass 14. Viewable through the main door is three slot reel assemblies 24. Each slot reel assembly is covered with a reel strip 32. The reel strip 32 is covered with various symbols that are displayed during the course of a game being played on the slot machine. The reel assemblies are behind a display panel 26 of some type. Above the main door is a video display monitor 6. The display monitor 6 will typically be a cathode ray tube, high resolution flat-panel LCD, or other conventional electronically controlled video monitor. The display monitor may add additional features to the game being played on the slot machine. Next to the reel assemblies is an information panel 8. The information panel 8 is a back-lit silk screened glass panel with lettering to indicate general game information including, for example, the number of coins played. On the side of the gaming machine is a slot reel handle 10. The slot reel handle 10 may be used by a player to activate the slot reels 24 during the course of a game. The bill validator 18, player-input switches 22, video display monitor 6, slot reel handle 10 and information panel 8 are devices used to play a game on the gaming machine 2. The devices are controlled by circuitry (not shown) housed inside the main cabinet 4 of the machine 2. Many possible types of slot machine games maybe provided with gaming machines of this invention.

When a user wishes to play the gaming machine 2, he or she inserts cash through the coin acceptor 20 or bill validator 18. At the start of the game, the player may initiate game play by pulling the slot reel handle 10 on the side of the gaming machine or by pressing one of the player input switches 22. During the game, the player may view additional game information and be presented with additional game options using the video display 6. Usually, during the course of a game, a player is required to make a number of decisions, which affect the outcome of the game. The player makes these choices using the player-input switches 22. During certain game events, the gaming machine 2 may display visual and auditory effects that can be perceived by the player. These effects add to the excitement of a game, which makes a player more likely to continue playing. Auditory effects include various sounds that are projected by the speakers (not shown). Visual effects include flashing lights, strobing lights or other patterns displayed from lights on the gaming machine 2 including lights behind the belly glass 14, from patterns on the video display 6, or from lights on the reel assemblies 24. After the player has completed a game, the player may receive game tokens from the coin tray 16 which may be used for further games.

FIG. 1B is a perspective drawing of a gaming machine cabinet and slot reel assembly. The main cabinet 4 contains

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a reel shelf 28 which usually supports three reel assemblies 24. The reel assembly 24 contains a reel strip 32. The reel strip 32 will usually be covered with a number of symbols which are utilized during the game play. Each reel assembly 24 is usually plugged into a mating connector 30. The mating connector usually contains connections to a power source needed to operate the reel assembly 24 and communication connections to circuitry (not shown) housed within the main cabinet 4 of the machine 2. During a game, the reel assembly and its associated devices may be controlled, in part, by the circuitry within the main cabinet of the gaming machine and by peripheral control circuitry (not shown) located within the reel assembly.

FIG 1C is an exploded perspective drawing of the interior parts of a slot reel assembly. The reel is composed of two reel halves 34. The reel strip 32 is placed around the edges of the reel halves. The moment of inertia of the reel halves—which is a function of parameters including their diameter, shape, and material composition—is an important operational parameter of the reel assembly 24. The reel halves are supported by a reel chassis 36 which maybe mounted to the reel shelf 28 shown in FIG. 1B. Before a player initiates a game, each reel assembly is usually motionless with each symbol on the reel strip in some initial position. When the player initiates a game, the each reel may be set in a rotating motion by a stepper motor 38 mounted on the reel chassis 36 and connected to the reel halves 34. The stepper motor 38 accelerates the reel halves 34 to a certain angular velocity and then stops the reel halves at some predetermined position. The position of the reel strip on each of the reel assemblies 24 may determine the outcome of the game initiated by the player.

FIG. 2 is a block diagram depicting a slot reel gaming peripheral and its connection over a communication network to a master gaming controller in accordance with this invention. When a gaming machine 2 is operating, the master gaming controller 214 may communicate with a variety of gaming devices. This communication may be carried out using some type of standard communication protocol including a USB serial bus using a standard connection system 216. Details of the USB communication protocol and connection system will be described below with reference to FIGS. 5, 6, 7 and 8.

During a game, the master gaming controller 214 may control devices including a monitor printer 206, a touch screen 208, a display 210, a monitor 212, or a slot reel peripheral 200. Using the standard communication connections and the standard communication protocol, the master gaming controller 214 may send instructions to a device to perform a specific operation. These instructions may be in the form of low-level or high-level instructions. The master gaming controller 214 sends low-level instructions to devices that it directly controls. Examples of low-level instructions might include turning on a specific light, turning off a specific light, starting a motor, or stopping a motor. The master gaming controller may send highlevel instructions to the slot reel peripheral 200 (e.g., stop at the lemon symbol). The slot reel peripheral 200 is a device that contains, for example, a standard communication connection, a peripheral or slot reel controller 202, and connections to one or more peripheral devices on the slot reel. The slot reel controller 202 contains a microprocessor which may enable it to directly perform some operations based on the high-level instructions from the master gaming controller 214. Typically, the slot reel controller 202 controls one or more peripheral devices on the slot reel 204. For example the slot reel controller might control the stepper motor shown in

FIG. 1C. Further, the slot reel peripheral 200 may be configured to control other reel peripherals including the slot reel peripherals 220 and 230 so that the three slot reel peripherals may operate as one unit when receiving commands from the master gaming controller 214. Also, when the communication connections and the standard communication protocol are used, the slot reel controller 204 enables communication between the master gaming controller 214 and one or more peripheral devices on the slot reel 204.

FIG. 3 is a block diagram depicting a specific embodiment in which a slot reel gaming peripheral is connected over a communication network to a plurality of master gaming controllers in accordance with this invention. The master gaming controllers 302, 304, 306 are connected over a communication network 310 including a USB serial bus to the slot reel peripheral 312. Each master gaming controller may reside in a separate gaming machine. The slot reel peripheral 313 contains a reel controller 300 which may control one or more peripheral devices in the slot reel peripheral 312 including the big reel 308. During the course of game played on any of the gaming machines containing the master gaming controllers 302, 304, 306, the slot reel peripheral 312 might be operated from instructions sent by one or more of the master gaming controllers. For example, during certain game situations for games controlled by the master gaming controllers, one of the master gaming controllers might send a command to the slot reel controller 300 within the slot reel peripheral instructing the big reel 308 to spin and then stop at a certain position. This instruction might be in the form of low-level instructions sent directly to the big reel 308 or as high-level instructions sent to the slot reel controller 300. These instructions might be sent when a bonus situation occurs during one of the games being played on the gaming machines connected to the slot reel peripheral 312. Since the slot reel peripheral 312 may be shared by a plurality of gaming machines, the slot reel peripheral might be viewable by players playing games on all of these gaming machines connected to the slot reel peripheral. Further, the big reel 308 might be activated by combinations of game events occurring simultaneously on the different gaming machines controlled by the master gaming controllers 302, 304, 306.

FIG. 4 is a block diagram depicting a more detailed example of a slot reel peripheral in accordance with this invention. The slot reel peripheral 400 may be in communication with a master gaming controller 422 using a standard communication protocol such as USB and an associated connection system which will be described in detail in FIGS. 5, 6, 7, and 8. The slot reel peripheral may contain a number of peripheral devices including an effects light 404, a back light 406, a bar code detector 408, position sensors 410, tampering sensors 412, an electro-luminescence device 414, a sound device 416, a stepper motor 418, and a slot reel 420.

The effects lights 404 may include one or more lights located within the slot reel peripheral 400. These lights may be activated during the course of a game to add to the excitement of the game being played on the gaming machine. In the case where multiple lights are located on the slot reel peripheral, these lights may be activated in various patterns including strobing or flashing. The back light 406 is placed on the slot reel peripheral such that symbols on the reel strip of the slot reel 420 may be easily viewable by a player playing a game on the slot machine. The electro-luminescent device 414 may be a semi-conductor device of some type that may display various patterns depending on

the voltage that is applied to the device. For example, an electro-luminescent device 414 might be applied to a reel strip on a slot reel 420 to add additional symbols to reel strip. Depending on the voltage applied to the electro-luminescent device 414, a different symbol might appear at the same location on the reel strip of the slot reel 420. The sound device 416 might be placed on the slot reel peripheral 400 to provide various sound effects during the course of a game on the gaming machine. These sound effects might include the sound of a slot reel making a clicking noise or any other sound patterns which might add to the excitement and interest of the game being played on the gaming machine. The sound device might include a sound projection device of some type including one or more speakers and a sound amplifier to provide power to the sound projection device.

The slot reel 420 is covered with a reel strip which usually displays a number of symbols. For example, a slot reel is shown in FIGS. 1A, 1B, and 1C. When a game is being played on a slot machine, typically, the outcome of the game will be determined by symbols displayed on three or more slot reels located in the gaming machine. Different combinations of symbols may result in different game outcomes. The probability of a particular symbol appearing on a slot reel may be determined by software residing on the master gaming controller 422. When a game is initiated by a player playing a game on the slot machine, the master gaming controller may select a symbol that is to appear on each slot reel. The master gaming controller 422 may then send instructions to the slot reel peripheral 400 through the slot reel controller 402 to initiate a sequence where the slot reel 420 is spun and then stopped at a position corresponding to the symbol selected by the master gaming controller 422.

To verify the symbol displayed by the slot reel 420, the master gaming controller may attempt to determine the position of the slot reel 420 using position sensors 410 or read a bar code corresponding to each symbol using a bar code detector 408. The bar code detector 408 may employ a light sensor of some type to read bar code symbols on the back of the reel strip on the reel 420. Each bar code symbol may correspond to a particular symbol on the reel strip. After reading the bar code symbol, the bar code detector 408 may send this information to the master gaming controller 422 directly or through the slot reel controller 402. The position sensors 420 may be used to determine where the slot reel has stopped. These sensors may include detectors that monitor the position of the reel and the angular velocity of the reel when it is rotating. Typically, the position sensors are optical sensors. A plastic flag located on the periphery of the reel may pass through the optical sensor which is mounted on the chassis of reel (See FIG. 1C). When the flag passes through the sensor and occludes the light emitting from its emitter, the position of the reel may be determined. One or more flags may be used with the optical sensor to determine the position of the reel. The information from the position sensors may be used by the master gaming controller to verify that the slot reel has stopped in the predetermined position and to drive the stepper motor 418.

The motion of the slot reel 420 is controlled by the stepper motor 418 or any other drive mechanism sufficient to move the slot reel from one position to another. Based on parameters of the motor including acceleration constants and the step rate and on parameters of the wheel including the moment of inertia, the stepper motor may be used to start the slot reel 420 to rotate from an initial non-rotating position, accelerate the slot reel to an angular velocity and then decelerate the slot reel such that it stops at a predetermined position. The stepper motor 420 typically accelerates and

decelerates the slot reel in discrete steps. The step rate as a function of time needed to accelerate and decelerate a particular slot reel from an initial position to a final position may reside in the form of a table stored in memory and accessible by software located on the master gaming controller 422 or the slot reel controller 402. This table must match the operational parameters of the slot reel including the moment of inertia. When a table is employed that does not correspond to the parameters of a particular slot reel 420, the slot reel may stop at a final position different from the position selected by the master gaming controller 422.

Tampering sensors 412 may be located on the slot reel peripheral 400 to detect attempts to modify the operation of the slot reel peripheral. For example, an attempt to tamper with the slot reels might involve trying to get one or more slot reels on a gaming machine to stop at a position other than the position selected by the master gaming controller 422. This action might be performed to generate a false jackpot. The tampering sensors 412 may operate in conjunction with the bar code detector 408, the position sensors 410 and the master gaming controller to detect when tampering with the slot reel peripheral 400 may have occurred.

The devices comprising the slot reel peripheral may be controlled directly by the master gaming controller 422 via a series of low-level instructions or indirectly by the master gaming controller via high-level instructions to the slot reel controller 402 which then sends out the low-level instructions. For example, to spin up the slot reel 420 from an initial non-rotating position and then to spin it down to a final position, the stepper motor 418 might require a series of low level instructions including charge the motor, initiate the first step, first delay period, initiate the second step, second delay period, initiate the third step, third delay period, initiate the fourth step, fourth delay period, perform the final step, and stop the motor. When the slot reel is accelerating, the length of time of each delay period between successive steps may decrease. When the slot reel is decelerating the length of time of each delay period between successive steps may increase. The step rate, which is a function of the length of time of each delay period between successive steps, may be based on a table stored in memory corresponding to the particular slot reel. When the master gaming controller directly controls the stepper motor, the master gaming controller would send the series of low-level instructions to the stepper motor. However, with a slot reel peripheral 400 containing a slot reel controller 402, the master gaming controller might send a high-level instruction to the slot reel controller 402 corresponding to a series of low-level instructions for a particular device. The slot reel controller 402 may interpret the high-level instruction and convert it to a series of low-level instructions. For the stepper motor example described above, the low-level commands, charge the motor, initiate first step, step at rate 1, step at rate 2, step at rate 3, step at rate 4, perform final step, and stop the motor, might be initiated by the slot reel controller 402 after receiving a high-level instruction from the master gaming controller 422 like "move the slot reel 420 to position A."

The slot reel controller 402 may convert high-level instructions from the master gaming controller 422 to low-level operational instructions for one or all of the peripheral devices including the effects lights 404, the bar code detector 408, the position sensors 410, the tampering sensors 412, the electro-luminescent device 414, the sound device 416, the stepper motor 418 and any other peripheral device potentially connected to the slot reel peripheral. Some advantages of the slot reel controller 420 performing these operations are that the computational resources needed by the master

gaming controller 422 maybe reduced since the slot reel controller, which contains a microprocessor, is performing some operations that could be performed by the master gaming controller. Further, the maintenance required to replace a slot reel might be reduced when a slot reel peripheral is used. For example, a table of step rates is usually required to drive the stepper motor for a particular slot reel. When a new slot reel is installed on a gaming machine and the master gaming controller drives the stepper motor of the slot reel, a table to drive the stepper motor corresponding to the new slot reel maybe loaded into a memory device on the mother board containing the master gaming controller. Further, all the low-level commands and software needed to drive the stepper motor may also be loaded into memory on the motherboard. This process may be very time consuming. Using the slot reel peripheral, most of this information may be contained within the slot reel controller. Thus, the amount of information needed to be installed on the master gaming controller may be minimized when the slot reel peripheral is replaced. Details of the communication protocol and connections needed to implement a slot reel peripheral are described below with reference to FIGS. 5, 6, 7 and 8.

FIG. 5 is a block diagram depicting a slot reel peripheral and its connection to a master gaming controller. The master gaming controller 500 shown in FIG. 5 is housed within the main cabinet 4 of the gaming machine 2 shown in FIG. 1A. The master gaming controller 500 controls one or more games played on the gaming machine 2. Typically, the master gaming controller is connected to a motherboard or "back plane" 502, which is attached to the back of the main cabinet 4 of the gaming machine 2. The back plane 502 may include an acceptor (not shown) for mechanically engaging or latching to the master gaming controller 500 and a root expansion hub 506 containing one or more standard communications ports 508. The standard communication ports 508 are used to connect to other devices containing standard communication ports.

The standard communication ports 508, root expansion hub 506, hub 510 and hub 530 and the connections to the devices comprise a communication system that allows the master gaming controller 500 to communicate with devices connected to this system. The devices and the connections shown in the figure are only one embodiment of the present invention. Typically, a device is not required to be plugged into a particular port. Examples of devices, which might be connected to a root expansion hub 506 with standard communication ports 508 on a mother board 502 with a master gaming controller 500, include fiber optic conversion 504, a remote hub 510, a coin acceptor 516, a bill validator 514 and a slot reel peripheral 528. These devices may be housed within the main cabinet 4 of the gaming machine 2 or may reside outside of the main cabinet 4. Other examples of devices which might incorporate a standard communication port 508 that communicate with the master gaming controller 500, include the coin hopper 512, the bill validator 514, the coin acceptor 516, the button panel 518, the effects lights 536, the stepper motor 520, and the sound device 542. These devices might be connected directly to the mother board 502 containing the root expansion hub 506 using one or more of the standard communication ports 508 or through one or more devices containing standard communication ports, which are connected to the root expansion hub 506 on the mother board 502. For example, the coin hopper 512 is connected to a standard communication port 522 on the bill validator 514. The bill validator 514 is connected to the root expansion hub 506 on the motherboard 502 containing the master gaming controller 500.

The root expansion hub 506, which is integrated into the back plane 502, provides breakout connections for devices within the gaming cabinet without requiring additional hardware or non-integrated communication port expansion including the remote hub 510 or the hub 530. Typically, the connections to the root expansion hub 506 are from a connection to a root port within the circuitry of the master gaming controller 500 (i.e., the root port provided by circuitry incorporated into the master gaming controller 500). When the root expansion hub is connected to a root port on the master gaming controller 500, the root expansion hub 506 may be provided with a higher level of security than the other remote hubs including the hubs 510 and 530. In general, any hub can be provided with more or less security than other hubs in the gaming machine. The security for the hub may be provided by limiting access to the interior of the gaming machine using one or more doors with mechanical and/or electrical locking mechanisms. These locks may be monitored by the master gaming controller 500 using sensor devices including electric switches. Further, the ports 508 and 524 within the root expansion hub may have additional security features. For example, access to the ports may be limited using an electronic key or covers with mechanical locks which prevent access. Further, devices connected to these ports may be locked down to prevent the disconnection of a device. Further, electronic or mechanical sensors including evidence tape may be used on a particular port to determine whether a port has been accessed or not. One or more of these security features as well as other security features may be used to secure specific ports on the root expansion hub 506 or any other ports used to connect devices.

Using the standard communication ports 508 and the root expansion hub 506, the master gaming controller 500 may be removed from the acceptor on the mother board which is attached to the back plane 502 without disconnecting or rewiring any of the devices connected to the standard communication ports 508. Also, additional devices may be connected to the root expansion hub 506 on the motherboard 502 without rewiring the motherboard 502 and master gaming controller 500. For example, when the remote hub 510 is disconnected from one of the communication ports 508 on the root expansion hub 506 and replaced with a connection to another device, including but not limited to the slot reel peripheral 528, the coin hopper 512, the bill validator 514, or the coin acceptor 516, then the mother board 502 and the master gaming controller 500 would not need to be rewired.

Also, the standard communication ports in the root expansion hub 506, the hub 510, and the hub 530 may not accept connections to all types of devices to provide additional security. For example, the level of security on the standard communication port 524 might be higher than the other standard communication ports 508 on the root expansion hub 506. Thus, the standard communication port 524 on the root expansion hub 506 might accept connections only from devices requiring a higher level of security including but not limited to the bill validator 514, the coin acceptor 516, and the gaming peripheral 528. In this example, the master gaming controller 500 might not recognize input from the bill validator 514, the coin acceptor 516 or slot reel peripheral 528 unless these devices were connected through a standard communication port with a higher level of security including 524. This security may be provided by mechanical, electronic or software means or combinations thereof. For example, port 524 may be housed within a secure locking enclosure to ensure that no one can connect

or disconnect through that port without having the necessary key. As another example, the master gaming controller includes a temporary port or hub 501. Usually, this port 501 is used for an electronic key and is used for diagnostics and other secure operations on the master gaming controller. During operation of the gaming machine, a device is not typically connected through this port. Secure ports and data encryption help to meet the necessary security requirements for a gaming machine.

During the operation of the gaming machine 2, the master gaming controller 500 communicates with devices connected through the system of standard communication ports and connections. The master gaming controller 500 includes a memory storing software for executing a standard communication protocol that allows communication with the various devices using the standard communication connections. This communication protocol may include encryption capability for communicating with one or more devices. The master gaming controller 500 communicates with devices to obtain information about a device including whether it is operating properly or whether it is still connected. In FIGS. 6, 7, and 8, this communication process is described in more detail.

During a game, the master gaming controller 500 controls devices. Using the standard communication connections and the standard communication protocol, the master gaming controller 500 may send instructions to a device to perform a specific operation. These instructions may be in the form of low-level or high-level instructions. The master gaming controller 500 sends low-level instructions to devices that it directly controls. Examples of low-level instructions might include turning on a specific light, turning off a specific light, starting a motor, or stopping a motor. The master gaming controller may send high-level instructions to the slot reel peripheral 528. A slot reel peripheral 528 is a device that contains, for example, a hub 530 with standard communication connections, a peripheral controller or slot reel controller 534, and connections to one or more peripheral devices. Typically, the peripheral controller controls one or more peripheral devices. Also, when the communication connections and the standard communication protocol are used, the peripheral controller 534 enables communication between the master gaming controller 500 and one or more peripheral devices. Examples of some peripheral devices, which might be included as part of slot reel peripheral 528, are the effects lights 536, the stepper motor 538, the sound device 542, in FIG. 5 and the back light 406, the bar code detector 408, the position sensors 410, the tampering sensors 412, and the electro-luminescent device 414 in FIG. 4. The peripheral controller 534 controls the peripheral devices connected to the peripheral controller 534 including the effects lights 536, the stepper motor 538, and the sound device 542. When the master gaming controller 500 sends the high-level instruction to the slot reel peripheral 528 requesting an operation from a peripheral device controlled by the peripheral controller 534, the peripheral controller 534 receives a high-level instruction and converts it to the low-level instructions specific to the operation requested from the master gaming controller 500. For example, the master gaming controller 200 might send a high-level instruction to the slot reel peripheral 528 to "strobe" its lights 536. The peripheral controller 534 would receive this high-level instruction and send out a series of low-level instructions to the lights 536 including instructions to turn on and off specific lights at specified intervals. The high-level instruction set that allows the master gaming controller 500 to operate a peripheral device on a gaming peripheral

528 with a peripheral controller 534 is stored as device driver software on a memory device on the master gaming controller 500.

To present a primary game play on a gaming machine with slot reels, the master gaming controller 500 may typically send instructions that direct the operation of three or more slot reel peripherals 528. As an example, the master gaming controller may send instructions to three slot reel peripherals requesting that each of the three slot reel peripherals present a cherry symbol representing the outcome of a primary game play on the gaming machine. Each slot reel peripheral 528 may be modular such that one or more of the slot reel peripherals 528 can be disconnected from its standard communication connection without disconnecting other slot reel peripherals that act together to present a primary game play. As an example, a single slot reel peripheral 528 may be disconnected from a gaming machine with three slot reel peripherals for maintenance and replaced with another slot reel peripheral.

FIG. 6 is a block diagram depicting a more detailed example of a slot reel peripheral in accordance with this invention. The master gaming controller 500 is connected to the hub 530, which includes standard communication connections on the slot reel peripheral. The peripheral controller 534 is connected to the hub 530 using a peripheral connection 600. The peripheral connection 600 is connected to a transient and surge protector 604. The transient and surge protector 604 protects the peripheral controller from signals arriving on the peripheral connections, which might damage a control microprocessor 612.

Power from the master gaming controller 500 is transmitted to a power conversion unit 602. The power conversion unit 602 converts the voltage arriving from the master gaming controller 500 to voltages needed for the control microprocessor 612 of the peripheral controller 534 or any of the peripheral devices connected to the peripheral controller 534 including but not limited to the stepper motor 620, the effects lights 622 or the sound device 624. The peripheral devices may also receive power directly from the power supply unit (not shown) with or without using the power conversion unit 602. The power supply unit is usually contained within the main cabinet of the gaming machine.

Hardware needed to connect the slot reel controller or peripheral controller 534 to a specific peripheral device is located in the peripheral interface 618. At least one or more peripheral devices are connected to the peripheral interface 618. These peripheral devices may include the stepper motor 620, the effects lights 622, the sound device 624, slot reel, back light bar code detector, tampering sensors, positions sensors and electro-luminescent. The configuration of the peripheral controller 534, which includes information about the types of peripheral devices controlled by the peripheral controller 534, is stored in a non-volatile memory 616. When the peripheral devices on a slot reel peripheral are changed, the non-volatile memory 616 can be replaced or reprogrammed to incorporate the new configuration.

The peripheral controller contains a control microprocessor 612 that controls communication with the master gaming controller 500. Further, the control microprocessor 612 converts high-level instructions from the master gaming controller 500 requesting specific operations from the peripheral devices controlled by the peripheral controller 534 to low-level instructions needed to perform the operation. In one embodiment the control microprocessor 612 includes a fixed memory 610, a volatile memory 608, a timer 614, a fail-safe 615, and a master controller communication

606. In other embodiments, either the fixed memory 610 or the volatile memory 608 or both may be located outside of the control microprocessor.

The volatile memory 608 and fixed memory 610 may be upgraded using the volatile memory expansion 609 and the fixed memory expansion 611. The fixed memory expansion 611 might be in the form of an EPROM or flash memory. When flash memory is used, it may be possible to field upgrade the operating code of the peripheral controller. The volatile memory expansion 609 might be in the form of static RAM, which uses a long-life battery to protect the memory contents when power is removed.

In a preferred embodiment each slot reel peripheral containing a peripheral controller 534 contains an essentially identical control microprocessor 612. In such modular designs, the power conversion circuitry 602 and surge/transient protector circuitry will also be essentially identical from peripheral to peripheral. The only distinctions between peripheral controllers in individual peripherals will reside in the peripheral interface 618 and the information stored in non-volatile memory 616. This allows for rapid design and reduced maintenance of gaming machine peripherals.

Within the control microprocessor 612, the master controller communication 606 controls the communication between the peripheral controller 534 and the master gaming controller 500. The control microprocessor may be an off-the-shelf device including an Infineon Technologies C541U family of microcontrollers. The master controller communication 606 performs the communication using a standard communication protocol. Essentially, it implements the protocol associated with a standard communications protocol such as USB, IEEE1394, or the like. The timer 614 sends signals to the control microprocessor 612, which controls execution of code. The fail-safe 615 contains code, which is independent of the code in the control microprocessor 612. When code within the control microprocessor 612 is lost or malfunctions, the fail safe 615 will reset the entire slot reel peripheral. As an example, the fail safe 615 might expect a message from the control microprocessor 612, which includes "do not reset." When the fail safe 615 receives this message, the fail safe 615 will wait a specified interval for the next "do not reset" message. When the fail safe 615 does not receive a message including "do not reset" after a specified interval, the fail safe 615 resets the slot reel peripheral.

The fixed memory 610 is a read only memory, which is not lost when the control microprocessor 612 loses power. The fixed memory 610 stores general code that the control microprocessor 612 uses while operating. The code stored in the fixed memory 610 may be identical in every peripheral controller 534. To control a specific peripheral device, the control microprocessor 612 uses code stored in the fixed memory 610 in conjunction with peripheral device specific information stored in the non-volatile memory 616. The volatile memory 608 stores code, parameters, data from the peripheral devices and data from the master gaming controller 500 that the control microprocessor 612 needs to operate. The data in volatile memory 608 is lost when the control microprocessor 612 loses power. Critical information including the current state of peripheral devices is stored in the non-volatile memory 616. The non-volatile memory might be an EEPROM, flash card memory or a battery powered RAM. In the event of a power failure or some other malfunction, the information in non-volatile memory 616 is used to restore the slot reel peripheral to its state before the malfunction occurred. For example, when a player enters cash into the gaming machine 2 and initiates a

game, the current position of the slot reel can be stored in non-volatile memory 616 on the peripheral controller 534. After this information is stored in non-volatile memory, it will be available to determine the state of the machine 2 when any subsequent malfunctions occur.

FIG. 7 is a flow diagram depicting an example of the slot reel peripheral power-up and communication process with the master gaming controller. This process is described for one slot reel peripheral. For a plurality of slot reel peripherals, this process is implemented for each slot reel peripheral. When a slot reel peripheral loses power, which may include an accidental power loss or planned maintenance for the slot reel peripheral, the process in FIG. 7 is usually followed. When a slot reel peripheral first receives power, the standard control microprocessor, as an example see 612 in FIG. 6, executes self-diagnostics to confirm the peripheral is operating properly in block 700. The control microprocessor will load software stored in its fixed memory. With this software the control microprocessor will execute a series of self-diagnostics to determine that its various components are operating properly. These tests may include testing the processor, timer, fail safe and master communication controller functions of the control microprocessor.

After the control microprocessor completes its self-diagnostics in block 700, the slot reel peripheral's configuration and state history is loaded into the control microprocessor's volatile memory from non-volatile memory outside of the control microprocessor in block 710. The non-volatile memory stores information about the peripheral devices that are connected to the control microprocessor through the peripheral interface. This information tells the standard control microprocessor what type of slot reel peripheral it is controlling. The control microprocessor loads the information stored in the non-volatile memory and loads code stored in the control microprocessor's fixed memory into volatile memory on the control microprocessor to operate the peripheral devices. In FIG. 6, the control microprocessor 612, the volatile memory 608, the fixed memory 610, the non-volatile memory 616, and the peripheral interface 618 are one possible embodiment of the hardware needed to implement the process in block 710. One possible example of configuration information, which might be stored in non-volatile memory, is information describing the effects lights connected to the slot reel peripheral. The non-volatile memory might store information including the type of effects lights, the number of lights, the response time of the lights, the signal needed to turn the lights on, the signal needed to turn the lights off, the communication rate and the communication buffer size for the effects lights. As another example, the non-volatile memory might store configuration information for a stepper motor connected to the slot reel peripheral, this information might include the type of motor, the signal needed to turn the motor on, the signal needed to turn the motor off, the response time of the motor, the communication buffer size and the communication rate for the stepper motor.

In block 710, the control microprocessor loads the state history of the slot reel peripheral from the non-volatile memory. The state history includes game information that describes states of the peripheral devices of a slot reel peripheral that occur while a game is being played on a gaming machine. For example, state information stored in the non-volatile memory might include the status of the tampering sensors, the position of reels or the status of effects lights. When a gaming machine loses power or malfunctions during a game, the information stored in the

non-volatile memory is used to restore the gaming machine to the state in the game that occurred just before the power loss or malfunction. In general, when a gaming machine is being powered-up, the slot reel peripheral will initialize itself to a pre-determined "safe" state until the master controller connects to it. When communication is established between the slot reel peripheral and master gaming controller, the control microprocessor may attempt to transfer relevant state history information it has retrieved from its nonvolatile memory to the master gaming controller.

In block 720, after self-diagnostics and initializing itself to some state, the peripheral controller may test the peripheral devices that it controls. This step is optional. Examples of some tests the peripheral controller might execute include turning effects lights on and off on a light panel, advancing the stepper motor, determining the position of the reel, or projecting a sound pattern from a speaker.

In block 730, the peripheral controller establishes communication between the slot reel peripheral and the master gaming controller. Using the standard communication connections and the standard communication protocol, the peripheral controller establishes communication with the master gaming controller. One embodiment of the hardware needed for this communication process between the peripheral controller and the master gaming controller is shown in FIG. 6. One example of the initial communication sequence and data exchange between the peripheral controller and master gaming controller can be represented as a series of high-level questions. A typical sequence to establish communication might proceed as a message from the master gaming controller including "is anyone there?" The peripheral controller might respond, "yes" and the master gaming controller might ask, "what type of device are you?" Then, the peripheral controller might respond, "I am a slot reel peripheral of some type." To this question, the master gaming controller might respond, "what is your communication rate and buffer size?" The peripheral controller would send this information to the master gaming controller and the devices would continue to communicate. The questions described above are representative of the type of information that is passed between devices using a standard communication protocol. The actual information passed by the devices corresponding to the questions will be specific to the particular protocol.

There are many different standard communication protocols including USB or IEEE1394, and the like. Each of these protocols utilizes a standard communication sequence. But the standard communication sequence may vary depending on the type of protocol that is used. When the master gaming controller is using a USB protocol to communication over the standard communication, the following information or a portion of this information might be exchanged between the master gaming controller and peripheral controller: 1) release specification number, 2) device class, 3) subclass (e.g. version) 4) device communication protocol and revision, 5) Maximum receive and send packet sizes, 6) vendor identification, 7) product identification, 8) device release number, 9) manufacturer string, 10) product string, 11) device descriptor, 12) device protocol, 13) serial number, and 14) number of configuration interfaces. The USB standard is widely-known and described in various references such as *USB Hardware and Software*, John Garney, Ed Solari Shelagh Callahan, Kosar Jaff, Brad Hosler, published by Annabooks 11838 Bernado Plaza Court, San Diego, Calif., 92128, copyright 1998, ISBN 0-929392-37-X, which is incorporated herein by reference for all purposes.

After establishing communication with the slot reel peripheral, the master gaming controller queries the slot reel

peripheral for peripheral devices. This process is called the device enumeration sequence in block 740. One or more peripheral devices attached to the slot reel peripheral may communicate with the master gaming controller or may be controlled by the master gaming controller during the course of a game. In this step, the master gaming controller requests device information from the peripheral controller. Again, the information exchange between the master gaming controller and peripheral controller can be represented as a series of high-level questions. The format of the information exchange may vary depending on the communication protocol being used. As an example, the first question from the master gaming controller to the peripheral controller might be "do you have any devices?" When the slot reel peripheral replies "yes", the master gaming controller might ask "what is the device?" The peripheral controller will then send information to the master gaming controller, in some format or protocol established before the communication process began, as to the type of peripheral device. This device identification protocol is distinct from the communication protocol.

For certain devices requiring a higher level of security including but not limited to bill validators and coin acceptors, the master gaming controller might determine which port it is using. Using the device identification protocol and the port information, the master gaming controller may or may not communicate with the slot reel peripheral. It may issue an error message and prevent further operation if the device is not using a required port. As a specific example, the master gaming controller may require that an electronic key (e.g., a software dongle) be inserted into a port prior to operation of that port (as a security measure). When a peripheral device is subsequently connected into the port where an electronic key has been used, the master gaming controller may only communicate with certain types of devices that are allowed access into this port based on the information provided by the electronic key.

In block 750, the master gaming controller initializes one or more selected device drivers for the peripheral device identified in block 740. Using a device identification number or some other system for identifying the peripheral device, the master gaming controller selects a software device driver, which will operate the features of the peripheral device enumerated in block 740. The master gaming controller first searches for a software driver, which exactly corresponds to the peripheral device. When the master gaming controller can not locate a software driver who exactly corresponds to the peripheral device, the master gaming controller may search for a similar software driver that might operate all or some of the features of the peripheral device. Examples of peripheral devices on a slot reel peripheral which might be operated by a master gaming controller using a software driver include effects lights, sound devices, stepper motors, position sensors, bar code detectors, back lights, tampering sensors and electroluminescent devices. After choosing a software driver, the master gaming controller makes the software available for use. Usually, this is done by loading the software into memory. When a software driver can not be located for a particular peripheral device, the master gaming controller does not operate this device during the game. When the peripheral device without a software driver is critical for operation of the gaming machine, the master gaming controller may generate an error message.

In block 740, to select the software driver, the master gaming controller may use a device identification protocol. As an example, the device identification protocol might

include a series of numbers which correspond to a specific peripheral device. As an example, combinations of the device class, manufacturer, device protocol and serial number information from a particular device might be used. From these numbers, the master gaming controller would be able to identify the type of the peripheral device and its features. Related peripheral devices with similar features might have similar numbers. For example, two versions of a peripheral device, device A and device B might share in common one or more numbers including 11112 to denote device A and 11113 to denote device B. This is similar to the concept of an address mask in network technology. This selection process may vary depending on the peripheral's manufacturer and the driver implementation.

In block 760, the master gaming controller determines whether the device enumeration sequence is completed. When more devices need to be enumerated, the master gaming controller returns to block 740. In block 760, the master gaming controller might determine whether more devices need to be enumerated by querying the peripheral controller or the master gaming controller might know the number of peripheral devices connected to the slot reel peripheral by its type. The type of the slot reel peripheral was identified when communication was established in block 730. In block 770, when the enumeration process is completed for all the peripheral devices connected to a peripheral controller, the master gaming controller may look for additional peripheral devices connected to other peripheral controllers to enumerate and return to block 740. For example, the master gaming controller may repeat the enumeration procedure for each slot reel peripheral on the gaming machine. When all of the peripheral devices connected to all the peripheral controllers are enumerated, the process shown in FIG. 7 is complete.

One advantage of the enumeration and device driver initialization process in blocks 740, 750, 760 is that enumeration may occur at any time while the machine is running. For example, when lights connected to the slot reel peripheral are not functioning, the lights could be removed from the slot reel peripheral for repair and replaced with a new set of lights while the gaming machine is running and the master gaming controller might unenumerate the old lights and then enumerate the new lights. Potentially, the power-up and communication process in FIG. 7 might be carried out by the master gaming controller without intervention by an attendant or other maintenance person.

FIG. 8 is a flow diagram depicting some details of the communication with a peripheral device on a slot reel peripheral via a standard peripheral interface in block 505 in FIG. 5. In the power-up phase described in FIG. 7, the master gaming controller establishes communication with the slot reel peripheral and selects software drivers for the peripheral devices the master gaming controller can operate. In block 600, the master gaming controller may use the software driver to send the peripheral controller on the slot reel peripheral a high-level instruction that requests the operation of a specific feature of the peripheral device. This high-level instruction is sent using the standard communication connection hardware and the standard communication protocol. A possible hardware embodiment of this process was shown in FIG. 5. For effects lights, examples of a potential high-level instructions might include "strobe lights", "flash lights", "implement light pattern A", or "implement light pattern B". For a stepper motor, examples of potential high-level instructions might include "apply power to the motor", "advance ten steps at 4 steps per second", or "stop motor." Further high-level instructions

might be sent to other types of peripheral devices including bar code detectors, back lights, sound devices, electro-luminescent devices, position sensors, or slot reels. In block 610, the peripheral controller receives a high-level instruction for a peripheral device and converts the high-level instruction into one or more low-level instructions that are needed to perform the specific operation on the peripheral device. For example, a high-level instruction from the master gaming controller to "strobe lights" on a effects light panel with 3 lights connected to the slot reel peripheral might be converted to a sequence low-level instructions including "turn on light 1", "wait 100 milliseconds", "turn off light 1", "turn on light 2", "wait 100 milliseconds", "turn off light 2", "turn on light 3." In block 620, the peripheral controller or slot reel controller sends the device specific low-level instructions through the peripheral interface to the peripheral device. The sequence of low-level instructions sent from the peripheral controller allows the peripheral device to perform the operation requested by the master gaming controller.

Although the foregoing invention has been described in some detail for purposes of clarity of understanding, it will be apparent that certain changes and modifications may be practiced within the scope of the appended claims. For instance, while the gaming machines of this invention have been depicted as having accessible slot reel peripherals physically attached to a main gaming machine cabinet, the use of gaming devices in accordance with this invention is not so limited. For example, the devices commonly provided on a top box may be included in a stand alone cabinet proximate to, but unconnected to, the main gaming machine chassis.

What is claimed is:

1. A slot reel peripheral comprising:
 - a slot reel assembly comprising:
 - a drive mechanism;
 - a single slot reel that is moved from position to position by the drive mechanism;
 - a peripheral controller that directly controls the drive mechanism; and
 - a peripheral communications connection for connecting the peripheral controller to a master gaming controller.
2. The slot reel peripheral of claim 1 wherein the drive mechanism is a stepper motor.
3. The slot reel peripheral of claim 1, further comprising one or more peripheral devices also controlled by the peripheral controller.
4. The slot reel peripheral of claim 3, wherein the peripheral device is an effects light, a position sensor, a bar code detector, a back light, a tampering sensor, a stepper motor, a sound device or an electro-luminescent device.
5. The slot reel peripheral of claim 3 further comprising a peripheral interface that directly connects to the one or more peripheral devices.
6. The slot reel peripheral of claim 5, wherein the peripheral controller includes a memory storing software for a communication protocol that allows communication with the peripheral devices via the peripheral interface.
7. The slot reel peripheral of claim 1, further comprising a hub connected to the peripheral communications connection and containing a plurality of peripheral communications connections.
8. The slot reel peripheral of claim 1, wherein the peripheral controller includes a control microprocessor that controls communication over the peripheral communications connection.

9. The slot reel peripheral of claim 1, wherein the peripheral controller includes a non-volatile memory arranged to store at least one of a) configuration parameters specific to the slot reel peripheral, b) state history information of the slot reel peripheral.

10. The slot reel peripheral of claim 9, wherein the non-volatile memory stores configuration parameters needed to drive the slot reel using the drive mechanism including a moment of inertia of the slot reel, a size of the slot reel and one or more acceleration parameters.

11. The slot reel peripheral of claim 1, wherein the peripheral controller is configured to communicate with a plurality of other slot reel peripherals.

12. The slot reel peripheral of claim 1, wherein the slot reel peripheral is modular and can be disconnected from the master gaming controller without disconnecting other slot reel peripherals that act together with the slot reel peripheral to present a primary game play.

13. A gaming machine comprising:

- a master gaming controller that controls one or more games played on the gaming machine; and
- at least one slot reel peripheral, each slot reel peripheral comprising:
 - a slot reel assembly comprising:
 - a drive mechanism;
 - a single slot reel that is moved from position to position by the drive mechanism;
 - a peripheral controller that directly controls the drive mechanism; and
 - a peripheral communications connection connecting the peripheral controller to the master gaming controller.

14. The gaming machine of claim 13, wherein the gaming machine is a video slot machine.

15. The gaming machine of claim 13, wherein the master gaming controller includes a memory storing software for a standard device identification protocol for at least some of the slot reel peripherals.

16. The gaming machine of claim 13, wherein the master gaming controller includes a memory storing one or more device drivers for the at least one slot reel peripheral.

17. The gaming machine of claim 13, wherein the master gaming controller includes a memory storing software for a communication protocol that allows communication with the at least one slot reel peripheral via the peripheral communications connection.

18. The gaming machine of claim 13, wherein the slot reel peripheral includes a memory storing software for a communication protocol that allows communication with the master gaming controller via the peripheral communications connection.

19. The gaming of claim 13, wherein the slot reel peripheral is configured to receive high-level instructions from the master gaming controller that do not specify precise control of the drive mechanism of one of the slot reel peripherals, and wherein the peripheral controller of the one of the slot reel peripherals provides low-level instructions precisely controlling the operation of its drive mechanism and following the high-level instructions.

20. The gaming machine of claim 13, wherein a first slot reel peripheral is configured to communicate high-level instructions that do not specify precise control of the drive mechanism of a second slot reel peripheral, and wherein the peripheral controller of the second slot reel peripherals receiving high-level instructions from the first slot reel peripheral provides low-level instructions precisely controlling the operation of its drive mechanism and following the high-level instructions.

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21. The gaming machine of claim 13, wherein the gaming machine includes at least three slot reel peripherals acting together to present a game play.

22. A gaming machine network comprising;

(a) a slot reel peripheral comprising;

a slot reel assembly comprising;

one or more drive mechanisms;

one or more slot reels moved from position to position by the one or more drive mechanisms;

a peripheral communications connection; and

a peripheral controller that directly controls the drive mechanism; and

(b) a plurality of gaming machines each gaming machine comprising;

a master gaming controller that controls the slot reel peripheral; and

a peripheral communication connection configured to communicate with the slot reel peripheral.

23. The gaming machine network of claim 22, wherein the slot reel peripheral is configured to receive high-level instructions from the plurality of master gaming controllers that do not specify precise control of the one or more drive mechanisms of the slot reel peripheral, and wherein the peripheral controller of the slot reel peripheral provides low-level instructions precisely controlling the operation of its one or more drive mechanisms and following the high-level instructions.

24. The gaming machine network of claim 22, wherein the gaming machine is a video slot machine.

25. A method for controlling operation of a slot reel peripheral on a gaming machine, the slot reel peripheral containing (i) a single slot reel, (ii) a peripheral controller, (iii) a standard peripheral communications connection for connecting the peripheral controller to a master gaming controller and (iv) one or more peripheral devices, the method comprising:

receiving a high level instruction for controlling the slot reel peripheral from a first master gaming controller via the standard peripheral communications connection to the peripheral controller, wherein the high level instruction does not precisely specify how the slot reel peripheral must perform an operation associated with the high level instruction;

converting the high level instruction to one or more low level operating instructions with the peripheral controller

controlling operation of the one or more peripheral devices with the peripheral controller and the one or more low level operating instructions.

26. The method of claim 25, wherein one or more of the peripheral devices are selected from the group consisting of an effects light a position sensor, a bar code detector, a back light, a tampering sensor, a stepper motor, a sound device or an electro-luminescent device.

27. The method of claim 25, further comprising

storing state history information in the slot reel peripheral, said state history information specifying a recent operating state of the slot reel peripheral;

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transmitting the stored state history information to the first master gaming controller.

28. The method of claim 25, further comprising receiving a high level instruction for controlling the slot reel peripheral from a second slot reel peripheral via a standard peripheral connection.

29. The method of claim 25, further comprising receiving a high level instruction for controlling the slot reel peripheral from a second master gaming controller via a standard peripheral connection said second master gaming controller different from said first master gaming controller.

30. A slot reel peripheral comprising:

a slot reel assembly comprising:

a drive mechanism;

a single slot reel that is moved from position to position by the drive mechanism;

a peripheral controller that directly controls the drive mechanism; and

a Universal Serial Bus (USB) communications connection for connecting the peripheral controller to a master gaming controller.

31. A gaming machine comprising:

a master gaming controller that controls one or more games played on the gaming machine; and

at least one slot reel peripheral, each slot reel peripheral comprising:

a slot reel assembly comprising:

a drive mechanism;

a single slot reel that is moved from position to position by the drive mechanism;

a peripheral controller that directly controls the drive mechanism; and

a Universal Serial Bus (USB) communications connection connecting the peripheral controller to the master gaming controller.

32. A method for controlling operation of a slot reel peripheral on a gaming machine, the slot reel peripheral containing (i) a single slot reel, (ii) a peripheral controller, (iii) a Universal Serial Bus (USB) peripheral communications connection for connecting the peripheral controller to a master gaming controller and (iv) one or more peripheral devices, the method comprising:

receiving a high level instruction for controlling the slot reel peripheral from a first master gaming controller via the USB peripheral communications connection to the peripheral controller, wherein the high level instruction does not precisely specify how the slot reel peripheral must perform an operation associated with the high level instruction;

converting the high level instruction to one or more low level operating instructions with the peripheral controller

controlling operation of the one or more peripheral devices with the peripheral controller and the one or more low level operating instructions.

* * * * *



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Sakamoto

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(45) Date of Patent: **Nov. 13, 2001**

(54) **GAME MACHINE AND METHOD WITH SHIFTING REELS IN TWO DIRECTIONS**

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(73) Assignee: **Aruze Corporation, Tokyo (JP)**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **09/438,782**

Primary Examiner—Michael O'Neill

(22) Filed: **Nov. 12, 1999**

(74) Attorney, Agent, or Firm—Venable; Richard L. Aitken

(30) **Foreign Application Priority Data**

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(51) Int. Cl.⁷ **A63F 9/24**

(52) U.S. Cl. **463/20; 273/143 R**

(58) Field of Search **463/20; 273/143 R**

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(57) **ABSTRACT**

A game machine comprises a plurality of cylindrical reels each provided with various kinds of symbols on its outer surface. The reels are axially aligned and independently rotatable about an axis in first and second directions. Part of symbols of the respective reels are displayed on a window having a predetermined winning line crossing over the symbol of the respective reels to define the symbols on the winning line as a symbol combination. The reels start rotating in the first direction in response to an operation of a start lever. The reels independently stop rotating in response to respective operations of stop buttons to bring the symbol of the corresponding reel to a standstill on the winning line to obtain the symbol combination after all reels are stopped rotating. The symbols are shifted in the first and second directions within a predetermined waiting time to change the symbol combination.

12 Claims, 21 Drawing Sheets

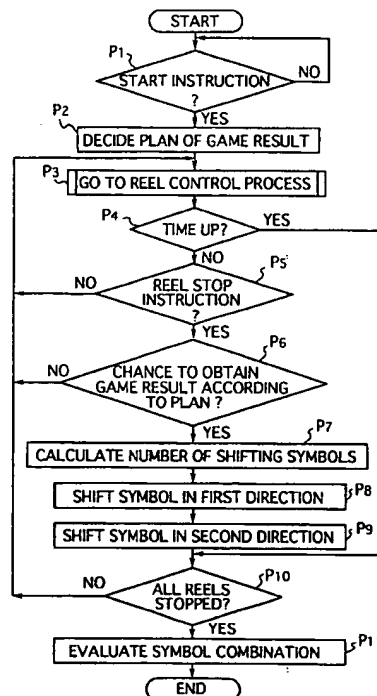


FIG. 1

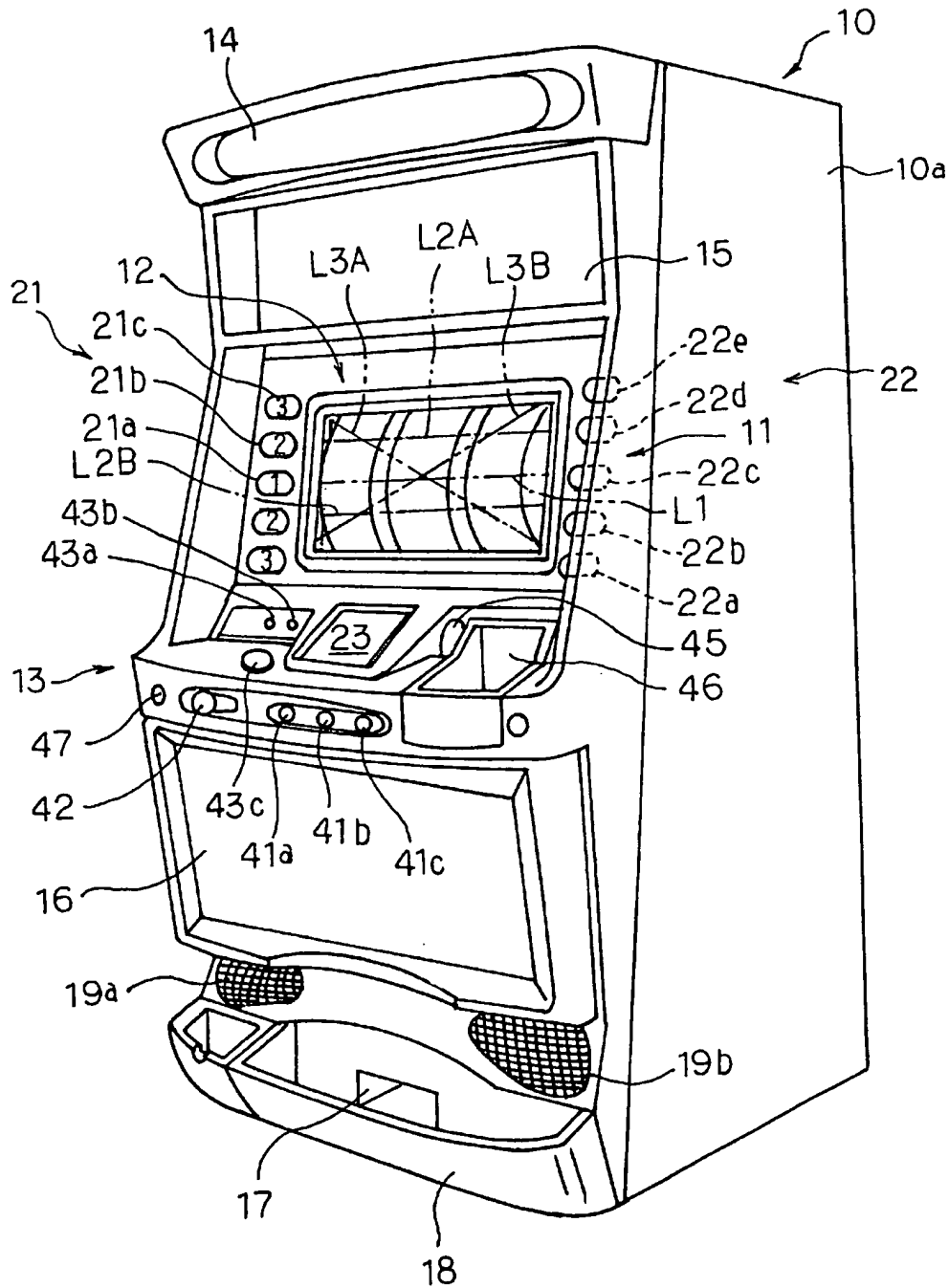


FIG. 2

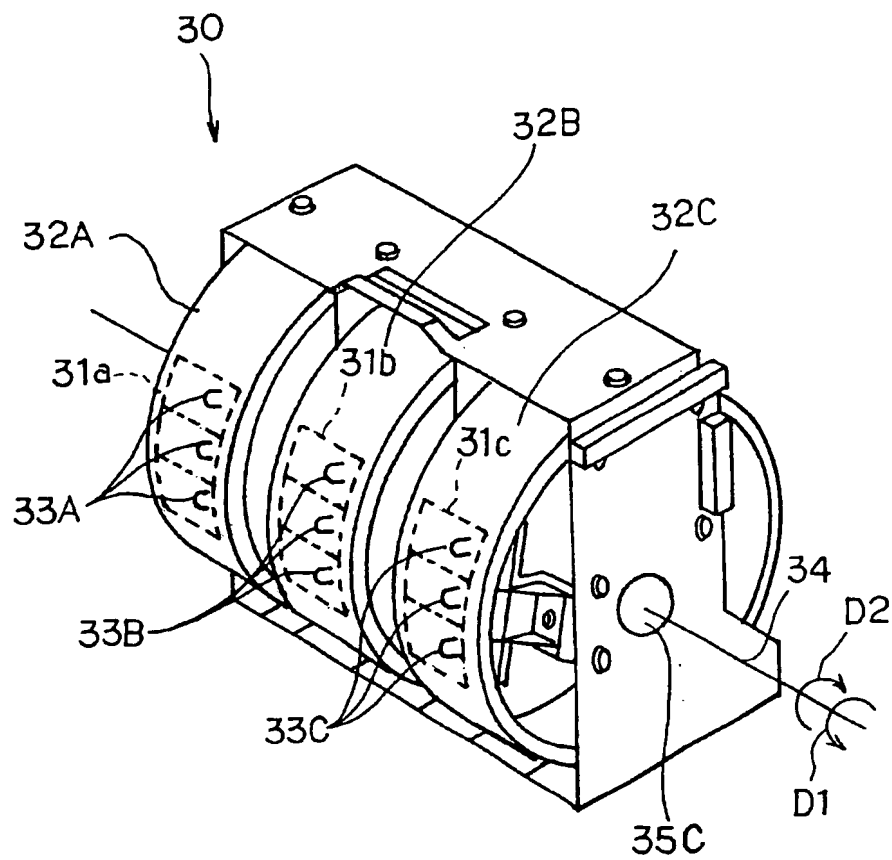


FIG. 3

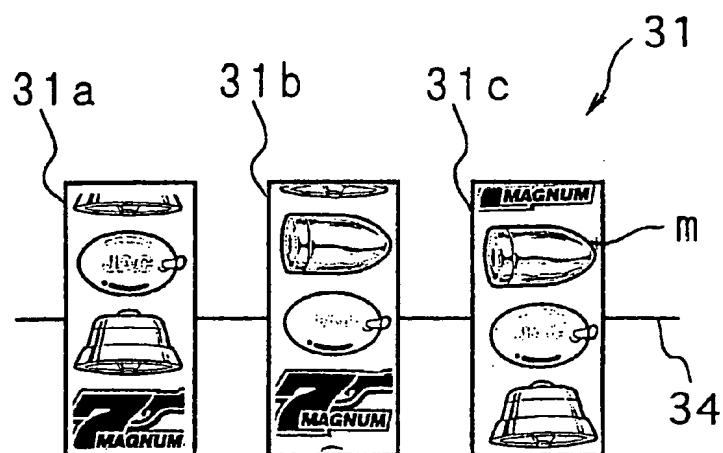


FIG. 4

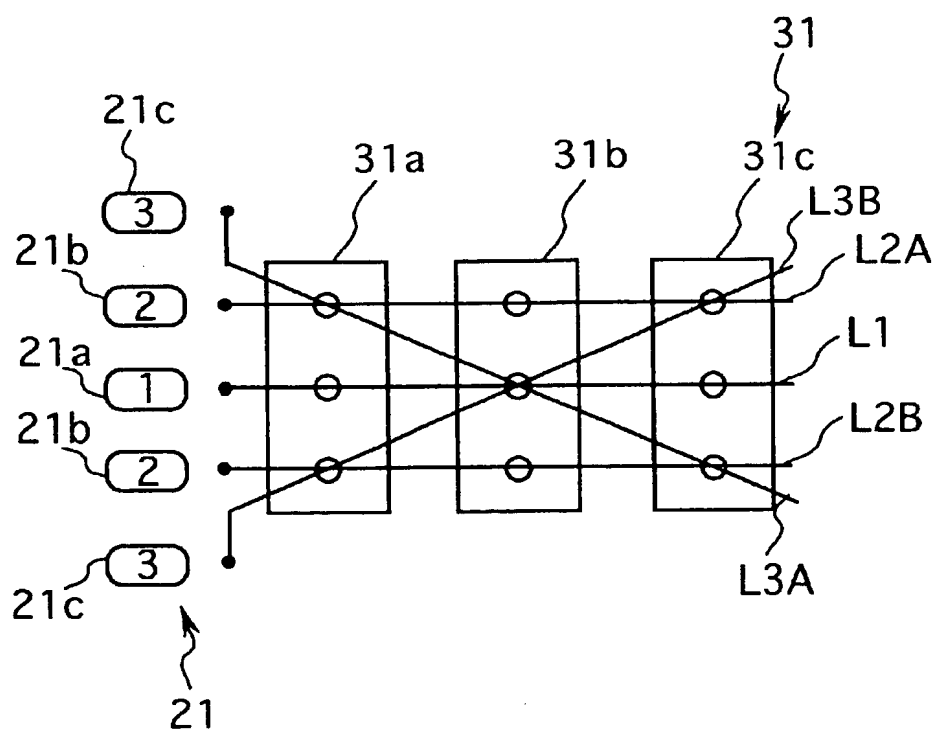


FIG. 5

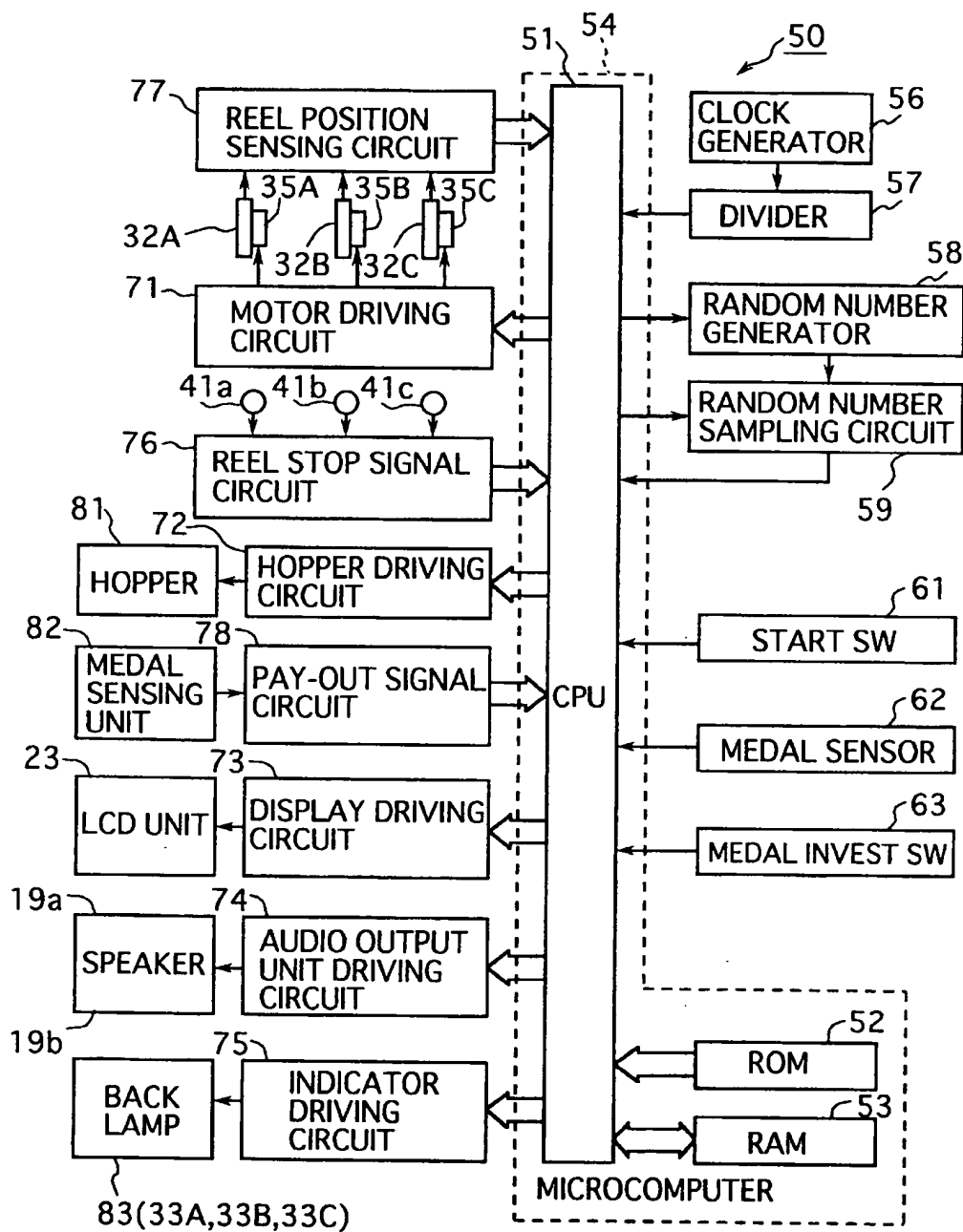


FIG. 6

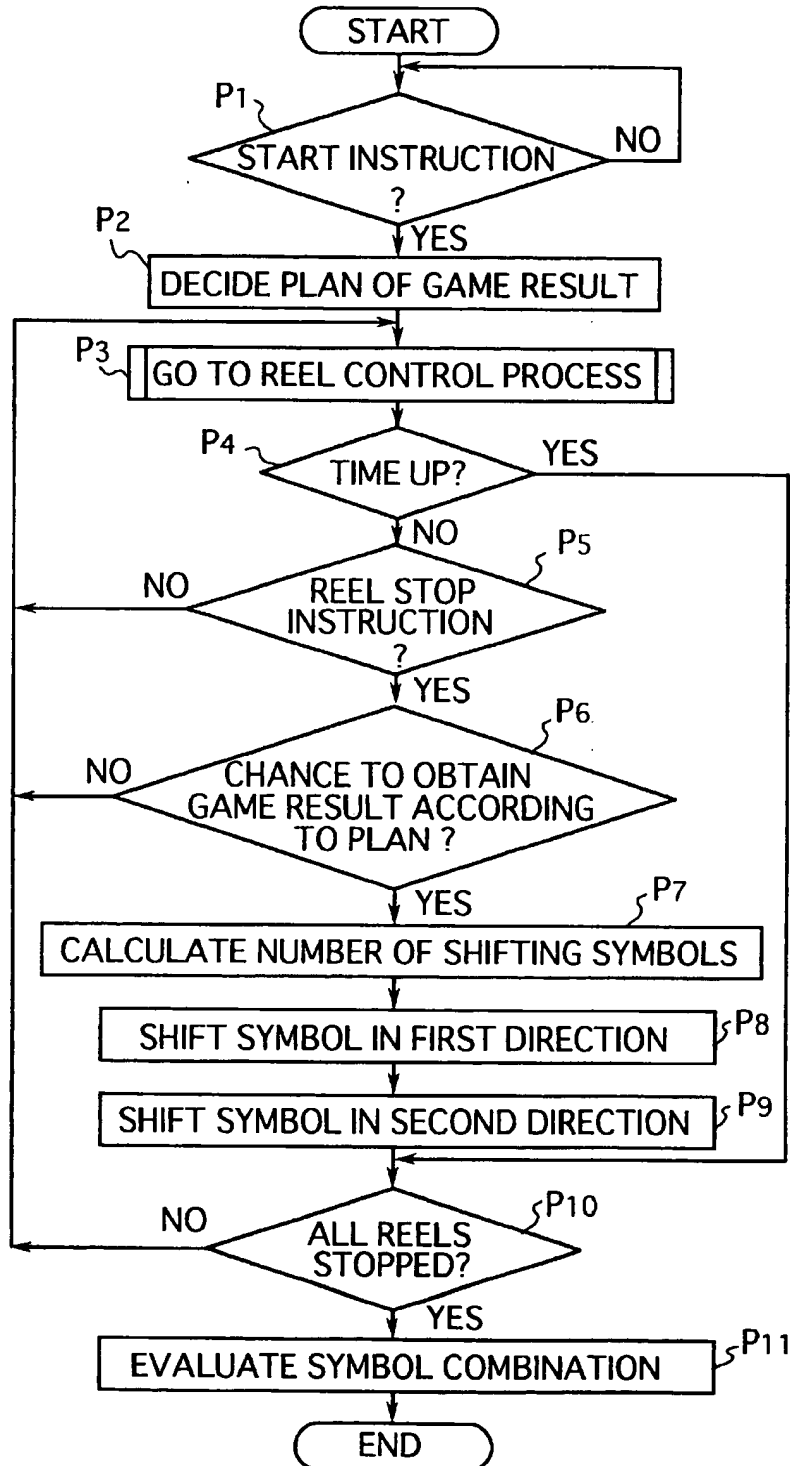


FIG. 7

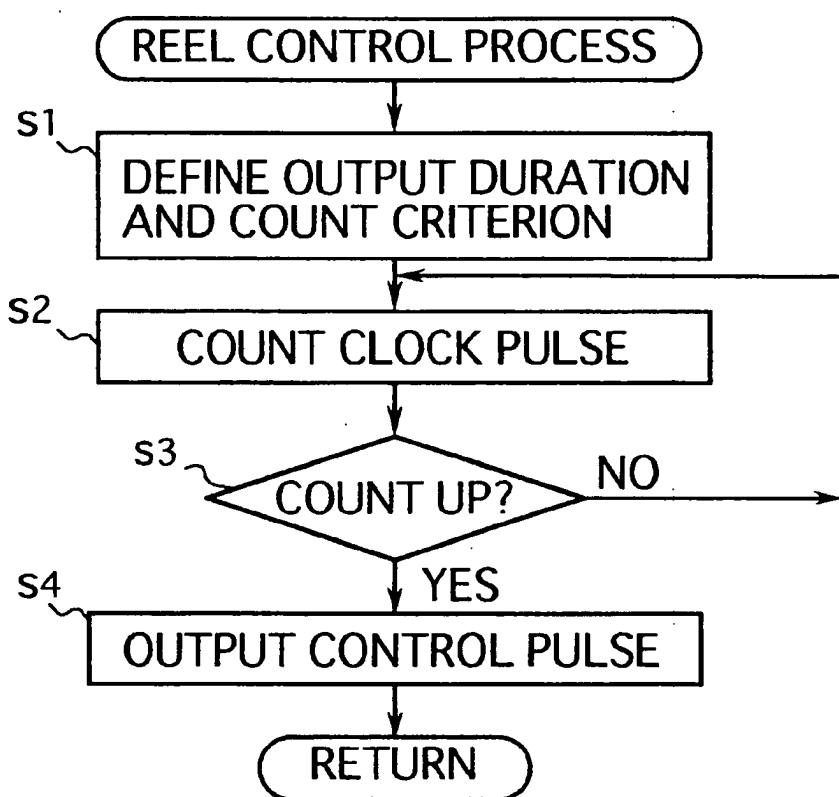


FIG. 8

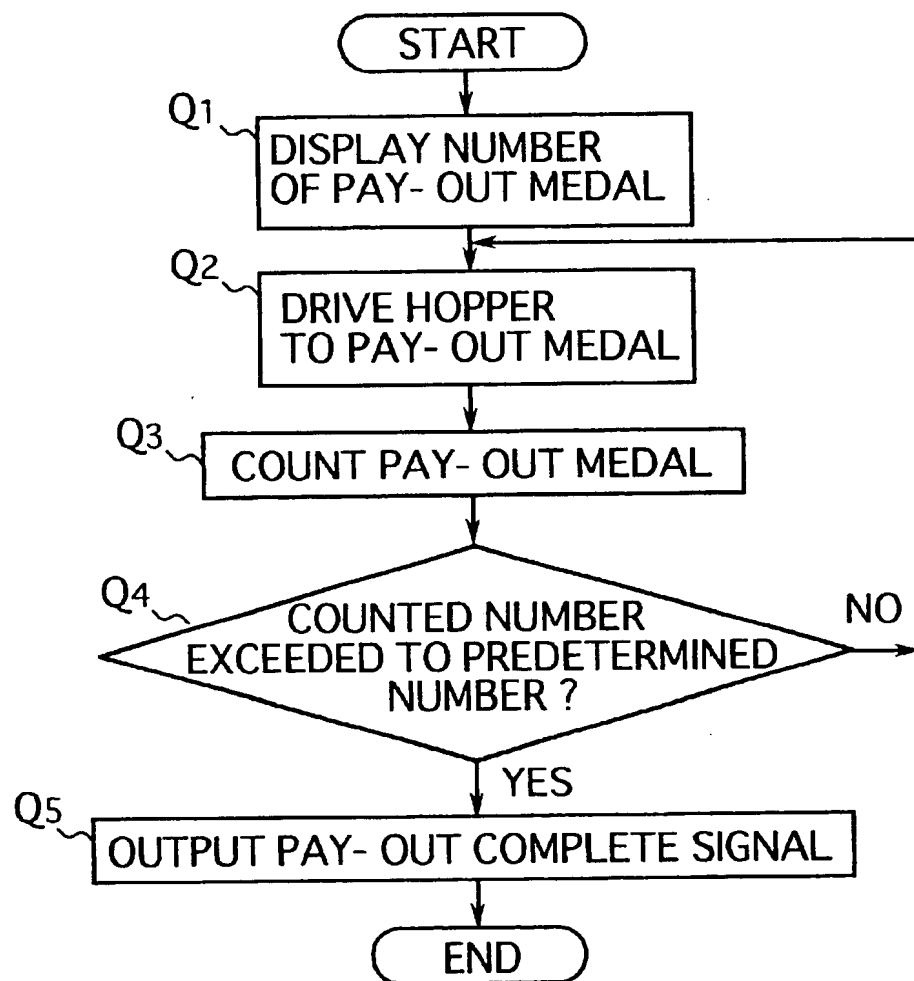


FIG. 9

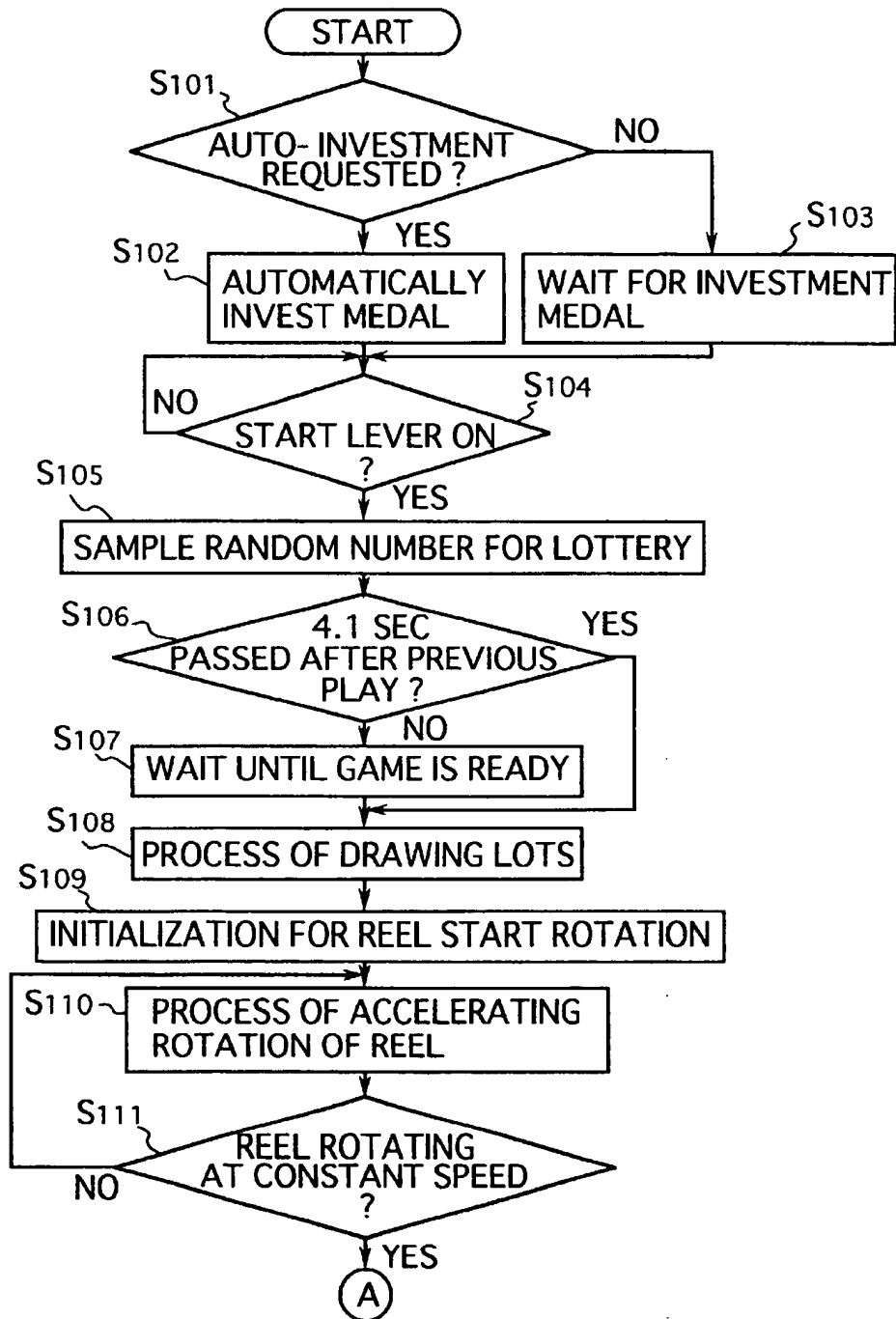


FIG. 10

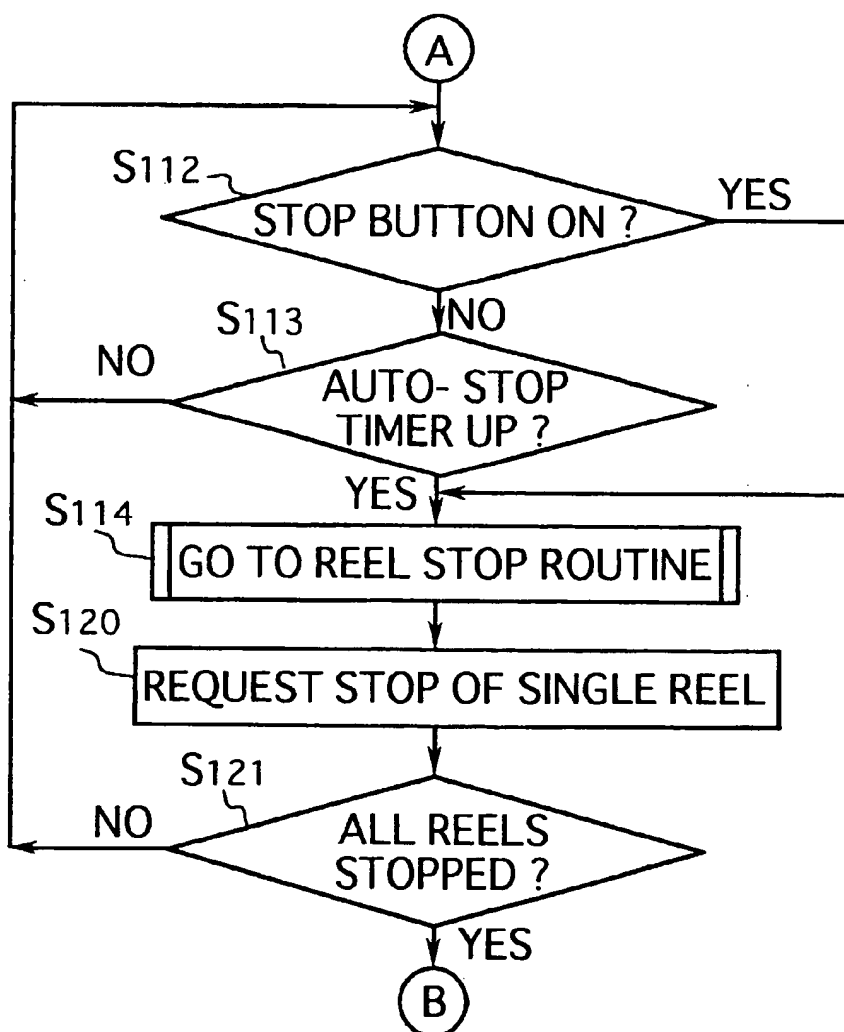


FIG. 11

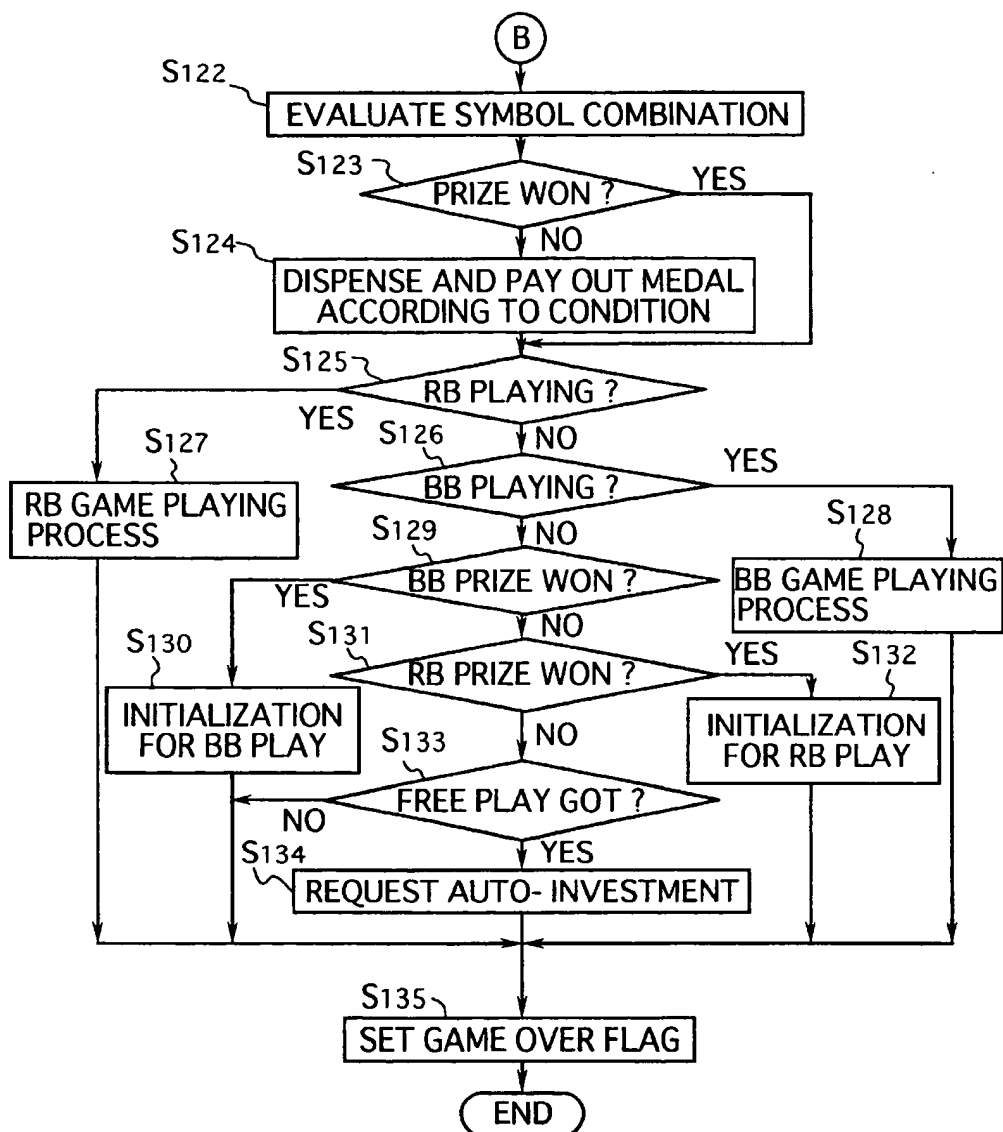
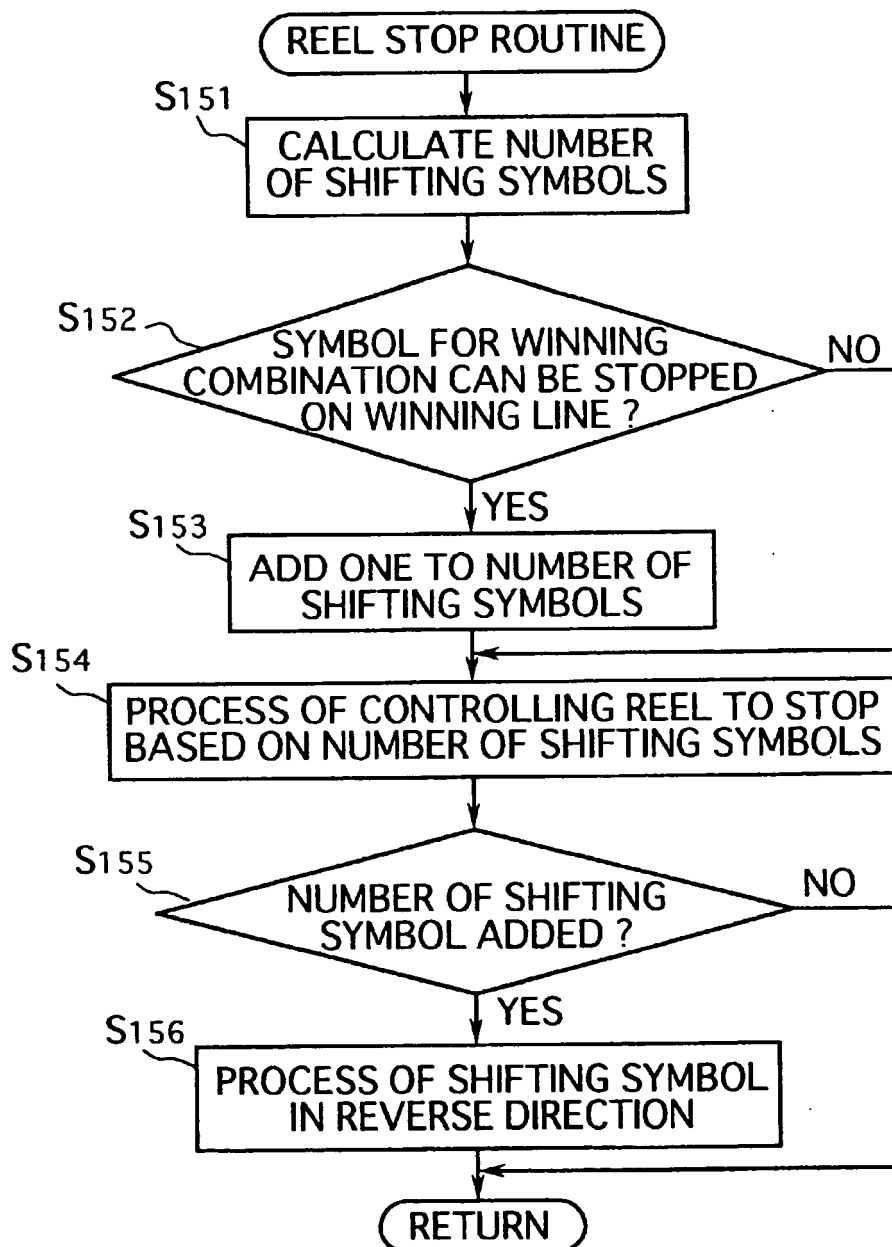


FIG. 12



F I G. 13

A1

REQUEST FOR WINNING	FLAG
FAILURE	0
BULLET	0
BELL	1
REPLAY	0
RB	0
BB	0

FIG. 14

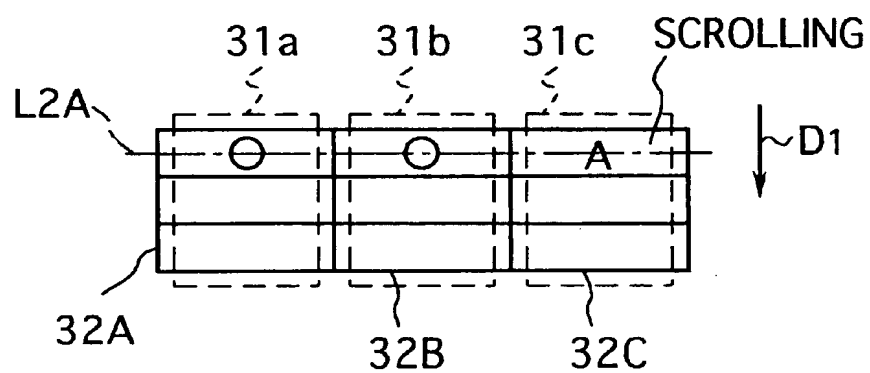


FIG. 15

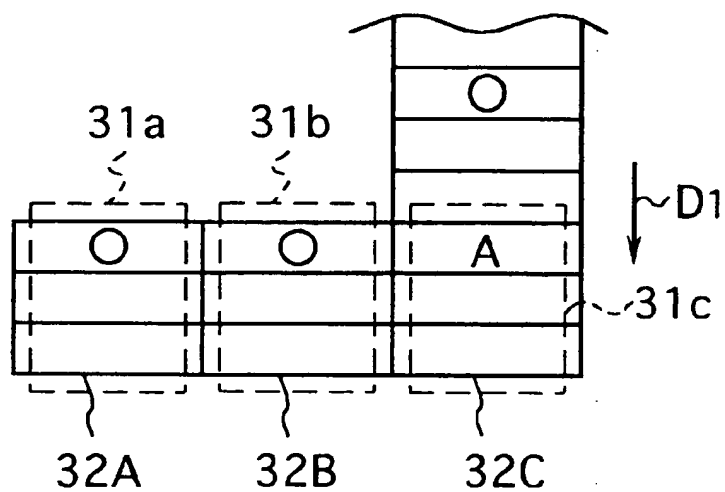
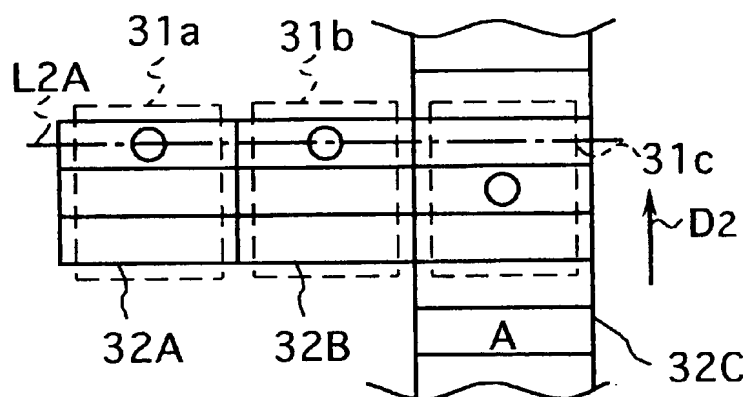
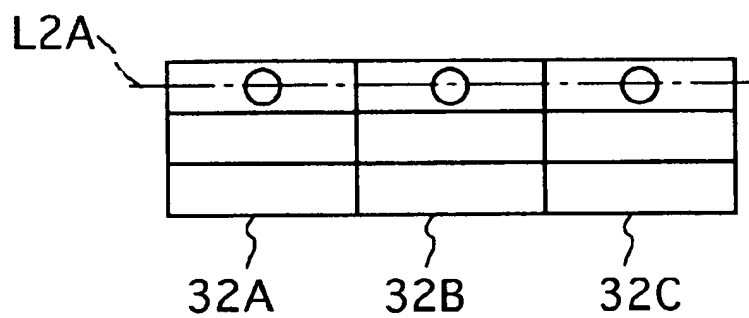
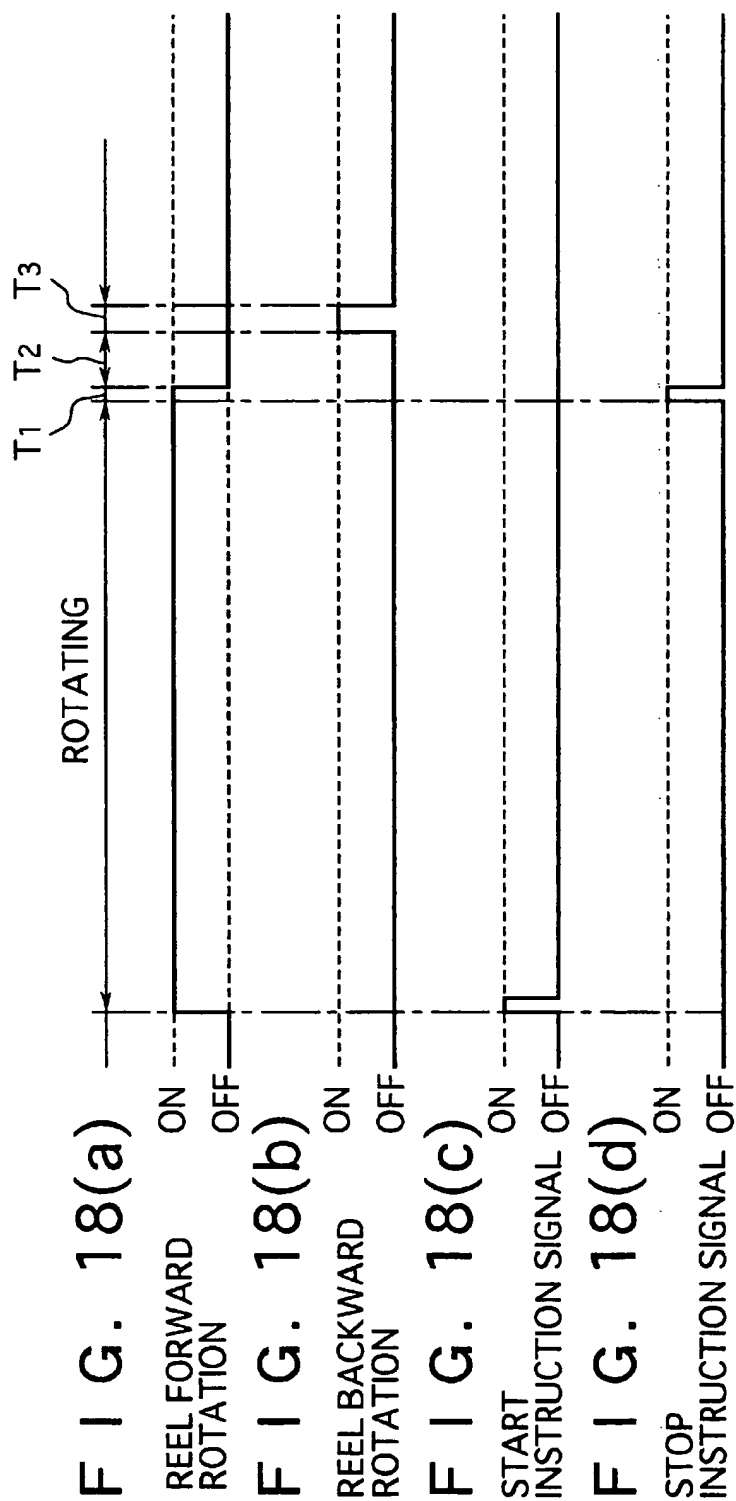


FIG. 16



F I G. 17





T1 : CONTROLLING TIME
T2 : OVER- RUN AND STOP OPERATING TIME
T3 : REEL BACKWARD ROTATING TIME

FIG. 19

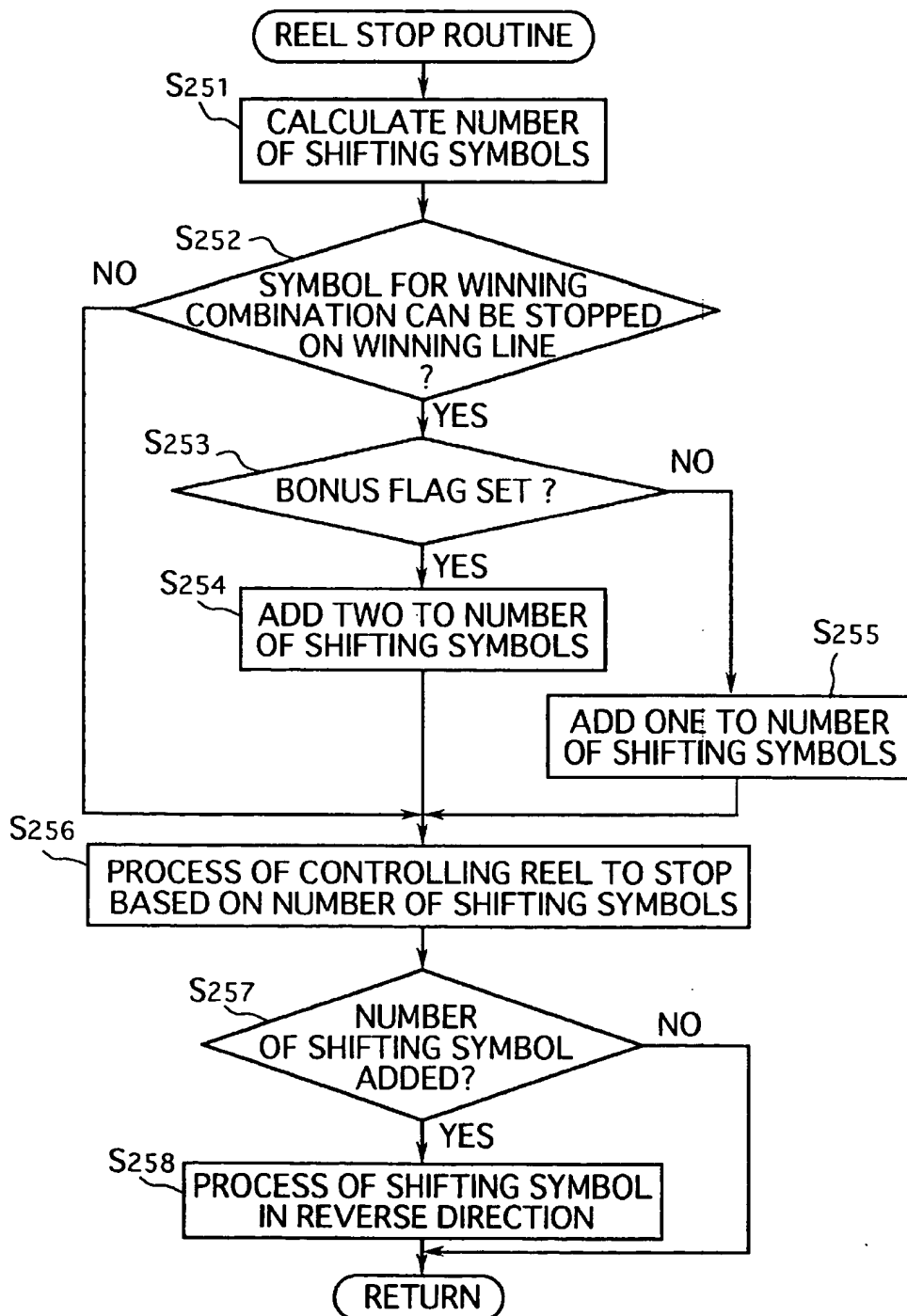
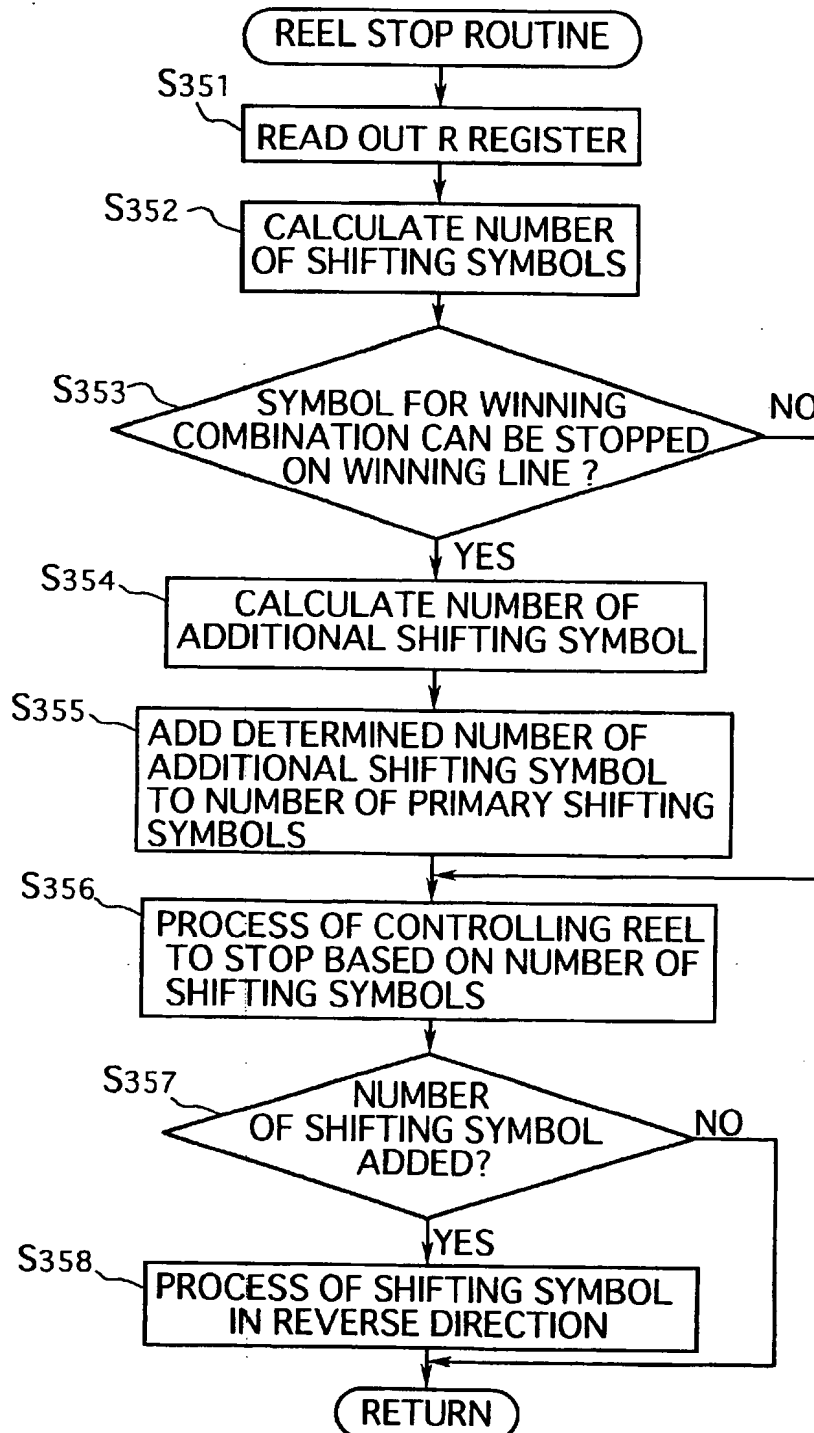


FIG. 20



F I G . 21

R REGISTER VALUE (0 - 127) LIST

R1
↙

FLAG	NO SHIFT	ONE SHIFT	TWO SHIFTS
FAILURE	0~124	125~127	
BULLET	0~90	90~125	126~127
BELL	0~50	51~120	121~127
REPLAY	0~100	100~125	126~127
RB	0~30	31~80	81~127
BB	0~10	11~40	41~127

1

GAME MACHINE AND METHOD WITH SHIFTING REELS IN TWO DIRECTIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a game machine and a method of controlling the game machine, and more particularly, a game machine, such as a slot machine, having a plurality of various kinds of symbols partially displayed and scrolled within a window and being designed to allow a player to stop the scroll of the symbols to decide the combination of symbols displayed within the window.

2. Description of the Related Art

There has been kept wide popularity of a game machine, such as a slot machine, comprising: a plurality of rotatable cylindrical reels each provided with various kinds of symbols on its outer surface at even intervals and independently rotatable about an axis; and a front panel having a window, through which some symbols of the reels are displayed, and a plurality of prize-winning lines on which the symbols of respective reels are positioned when the reels stop rotating. The game machine further comprises: a start lever for allowing the player to instruct the reels to start rotating and generating a start instruction; and a plurality of stop buttons for allowing the player to instruct the reels, respectively, to stop rotating and generating stop instructions respectively corresponding to the reels.

The reels stop rotating in response to the stop instructions, respectively, thereby resulting in the fact that the symbols of the reels are arranged on the prize-winning lines. The game machine is generally operated to evaluate the combinations of these symbols of the reels arranged on the prize-winning lines, and to then pay out a predetermined number of tokens as a prize if the combination of the symbols is coincident with any one of a plurality of predetermined winning combinations of the symbols.

Recently, the game machine of this type particularly called "pachi-slot" can be controlled by a microcomputer to display and scroll the symbols and to produce various visual and audio outputs, thereby making the game machine more attractive to the player.

More specifically, the game machine comprises controlling means, as representatively embodied by the microcomputer, for operating the reels in response to the player's instruction. The controlling means is operated to allow the rotating reels to stop rotating in response to the stop instructions, respectively, after a predetermined time, e.g., 190 msec determined by the existing Japanese law, has been passed since the stop instructions are respectively generated. The controlling means is further operated to previously decide a plan of the result of the game, to estimate the stop position of the last one of the reels to judge whether the combination of the symbols arranged on the winning line makes the result of the game coincident with the previously decided plan or not. The controlling means is, if necessary, operated to shift the position of the reel within the predetermined time to change the combination of the symbols in order to make the game result accord to the decided plan.

In the above conventional game machine, the reels can rotate in an only one-way direction. When the player pushes the stop button to issue the stop instruction, the corresponding reel cannot stop rotating in a moment, but decelerates and keeps it rotating to make the symbols shifted in the one-way direction by a predetermined number of symbols

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until the reel completely stops rotating. The number of shifting symbols is restricted within a predetermined number, e.g., 5 pieces of symbols. Commonly the player learns the arrangement of symbols on each reel by heart.

After stopping the reels excepting the last one of the reels, the player watches the rotating symbols carefully and waits for a chance of winning a desired prize, as taking into account the degree of the deceleration of the reel and the number of shifting symbols.

This means that it is necessary for the player to master a high technique for watching the timing of stopping the rotation of the reel and pushing the stop button at this timing in order to obtain a desired combination of symbols thereby winning a desired prize. This makes the game machine more attractive to the player.

However, in the conventional game machine as described above, once the player missed bringing the desired symbol to a standstill on the winning line, the player loses the chance of winning the prize if the rotation of the reel has been decelerated to a low speed inadequate to make the symbol come full circle, because the one-way rotation of the reels makes it impossible to correct the standstill symbol after the desired symbol passed over the prize-winning lines. The player can thus judge that there is no chance of winning the prize, and then fails to keep up interest in the game until all of reels are stopped to bring the symbols to a standstill on the prize-winning line.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a game machine in which the player can maintain a high expectation of winning until the symbols of all of reels are completely positioned on the effective prize-winning lines. The game machine can greatly excite the player just before the game result is determined.

It is another object of the present invention to provide a method of controlling a game machine in which the player can maintain a high expectation of winning until the symbols of all of reels are completely positioned on the effective prize-winning lines. The game machine can greatly excite the player just before the game result is determined.

In accordance with a first aspect of the present invention, there is provided a game machine for allowing a player to play a game comprising: displaying means capable of displaying a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order; scrolling means for allowing the displaying means to display part of the symbols of the respective symbol arrangements on a window having a predetermined winning line crossing over the symbol of the respective symbol arrangements to define the symbols positioned on the winning line as a symbol combination and to scroll the symbols of the symbol arrangements within the window in two different predetermined scroll directions including first and second scroll directions; scroll starting means for allowing the scrolling means to start to scroll the symbols of the symbol arrangements within the window in the first scroll direction in response to a predetermined start instruction; receiving means for receiving a plurality of stop instructions corresponding to the plurality of symbol arrangements; scroll stopping means for allowing the scrolling means to independently stop scrolling the symbols of the symbol arrangements in response to the plurality of stop instructions, respectively, received by the receiving means to bring the symbol of the corresponding symbol arrangements to a standstill on the winning line to obtain the symbol

combination after all of the symbols are stopped scrolling; shifting means for allowing the displaying means to shift the symbols of the symbol arrangements in the first and second scroll directions within a predetermined waiting time after the stop instructions, respectively, are received by the receiving means to change the symbol combination; and evaluating means for evaluating the symbol combination on the basis of a predetermined winning combination for winning.

In the above game machine, the symbols of each of the symbol arrangements may be aligned with a line substantially parallel with the first scroll direction, and the first scroll direction is opposite to the second scroll direction. Furthermore, the displaying means may include a plurality of rotatable cylindrical reels each provided with the various kinds of symbols arranged on its outer surface at predetermined intervals. The reels may be axially aligned and independently rotatable about an axis in the first and second directions.

In the above game machine, the shifting means may be operated to judge whether the symbol of each of the symbol arrangements positioned on the winning line is shifted or not on the basis of a predetermined game condition. Moreover, the shifting means may be operated to determine the number of shifting symbols of each of the symbol arrangements for shifting the symbols in the second scroll direction on the basis of the predetermined game condition. Furthermore, the shifting means may be operated to determine the number of shifting symbols of each of the symbol arrangements for shifting the symbols in the first scroll direction on the basis of the number of symbols of each symbol arrangements for shifting the symbols in the second scroll direction.

The above game machine may further comprise inputting means for allowing the player to input the stop instructions to the game machine.

The above game machine may further comprise deciding means for previously deciding a plan of the result of the game. The shifting means may be operated to judge whether there is a chance to obtain the result of the game according to the plan decided by the deciding means within the waiting time or not, and to shift the symbol in the first and second scroll directions so that the result of the game accords to the plan decided by the deciding means. Moreover, the plan decided by the deciding means may include a plan of the symbol combination for evaluating. The shifting means may be operated to judge whether the symbols of the symbol arrangement can be brought to a standstill on the winning line within the waiting time to obtain the symbol combination according to the plan decided by the deciding means or not, and to shift the symbol in the first and second scroll directions to change the symbol combination in accordance with the plan decided by the deciding means when the judgment is made that the symbols of the symbol arrangement can be brought to a standstill on the winning line within the waiting time to obtain the symbol combination according to the plan decided by the deciding means.

In accordance with a second aspect of the present invention, there is provided a method of controlling a game machine for allowing a player to play a game comprising the steps of:

- (a) forming a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order;
- (b) displaying part of the symbols of the respective symbol arrangements on a window having a predetermined winning line crossing over the symbol of the respective

symbol arrangements to define the symbols positioned on the winning line as a symbol combination;

- (c) scrolling the symbols of the symbol arrangements within the window in a first predetermined scroll direction in response to a predetermined start instruction;
- (d) receiving a plurality of stop instructions corresponding to the plurality of symbol arrangements;
- (e) stopping scrolling the symbols of the symbol arrangements in response to the plurality of the stop instructions, respectively, received in the step (d) to bring the symbols of the corresponding symbol arrangements to a standstill on the winning line;
- (f) obtaining the symbol combination after all of the symbol arrangements are stopped scrolling in the step (e);
- (g) shifting the symbols of the symbol arrangements in the first scroll direction within a predetermined waiting time after the step (d);
- (h) shifting the symbols of the symbol arrangements in a second predetermined scroll direction different from the first scroll direction within the waiting time;
- (i) performing the steps (g) and (h) to change the symbol combination; and
- (j) evaluating the symbol combination on the basis of a predetermined winning combination for winning.

In the above method, the symbols of each of the symbol arrangements may be aligned with a line substantially parallel with the first scroll direction, and the first scroll direction is opposite to the second scroll direction.

In the above method, the step (i) may have the step of judging whether the symbol of each of the symbol arrangements positioned on the winning line is shifted or not on the basis of a predetermined game condition. Moreover, the step (h) may have the step of determining the number of shifting symbols of each of the symbol arrangements for shifting the symbols in the second scroll direction on the basis of the predetermined game condition. The step (g) may have the step of determining the number of shifting symbols of each of the symbol arrangements for shifting the symbols in the first scroll direction on the basis of the number of symbols of each symbol arrangements for shifting the symbols in the second scroll direction in the step (h).

The above method may further comprise the step of allowing the player to input the stop instructions to the game machine.

The above method may further comprise the steps of:

- (k) deciding a plan of the result of the game;
- (l) judging whether there is a chance to obtain the result of the game according to the plan decided in the step (k) within the waiting time or not; and
- (m) performing the step (i) so that the result of the game accords to the plan decided in the step (k).

In the above method, the plan decided in the step (k) may include a plan of the symbol combination for evaluating. The step (l) may have the step of judging whether the symbols of the symbol arrangement can be brought to a standstill on the winning line within the waiting time to obtain the symbol combination according to the plan decided in the step (k) or not. The step (i) may have the step of performing the step (h) to change the symbol combination in accordance with the plan decided in the step (k) when the judgment is made in the step (l) that the symbols of the symbol arrangement can be brought to a standstill on the winning line within the waiting time to obtain the symbol combination according to the plan decided in the step (k).

In accordance with a third aspect of the present invention, there is provided a game machine for allowing a player to play a game comprising: displaying means capable of dis-

playing a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order; scrolling means for allowing the displaying means to display part of the symbols of the symbol arrangement on a window having a predetermined winning point and to scroll the symbols within the window in a first predetermined scroll direction; scroll starting means for allowing the scrolling means to start to scroll the symbols within the window in the first scroll direction in response to a predetermined start instruction; receiving means for receiving a predetermined stop instruction; scroll stopping means for allowing the scrolling means to stop scrolling the symbols in response to the stop instruction received by the receiving means to bring one of the symbols to a standstill at the winning point; shifting means for allowing the displaying means to shift the symbols in the first scroll direction and a second predetermined scroll direction different from the first scroll direction within a predetermined waiting time after the stop instruction is received by the receiving means to change the kind of the symbol positioned at the winning point; and evaluating means for evaluating the kind of the symbol positioned at the winning point on the basis of a predetermined kind of symbol for winning.

In the above game machine, the symbols may be aligned with a line substantially parallel with the first scroll direction, and the first scroll direction is opposite to the second scroll direction.

In the above game machine, the shifting means may be operated to judge whether the symbol positioned at the winning point is shifted or not on the basis of a predetermined game condition. Moreover, the shifting means may be operated to determine the number of shifting symbols for shifting the symbols in the second scroll direction on the basis of the predetermined game condition. Furthermore, the shifting means may be operated to determine the number of shifting symbols for shifting the symbols in the first scroll direction on the basis of the number of shifting symbols for shifting the symbols in the second scroll direction.

The above game machine may further comprise inputting means for allowing the player to input the stop instruction to the game machine.

The above game machine may further comprise deciding means for previously deciding a plan of the result of the game. The shifting means may be operated to judge whether there is a chance to obtain the result of the game according to the plan decided by the deciding means within the waiting time or not, and to shift the symbol in the first and second scroll directions so that the result of the game accords to the plan decided by the deciding means. In the above game machine, the plan decided by the deciding means may include a plan of the kind of symbol for evaluating. The shifting means may be operated to judge whether the symbol of the symbol arrangement can be brought to a standstill at the winning point within the waiting time to obtain the symbol according to the plan decided by the deciding means or not, and to shift the symbol in the second scroll direction to change the kind of the symbol in accordance with the plan decided by the deciding means when the judgment is made that the symbol of the symbol arrangement can be brought to a standstill at the winning point within the waiting time to obtain the symbol according to the plan decided by the deciding means.

In accordance with a fourth aspect of the present invention, there is provided a method of controlling a game machine for allowing a player to play a game, comprising the steps of:

(a) forming a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order,

(b) displaying part of the symbols of the symbol arrangement on a window;

(c) scrolling the symbols within the window in a first predetermined scroll direction in response to a predetermined start instruction;

(d) receiving a predetermined stop instruction;

(e) stopping the scroll of the symbols in response to the stop instruction received in the step (d) to bring one of the symbols to a standstill at a predetermined winning point provided with the window;

(f) shifting the symbol in the first scroll direction within a predetermined waiting time after the step (d);

(g) shifting the symbol in a second predetermined scroll direction different from the first scroll direction;

(h) performing the steps (f) and (g) to change the kind of the symbol positioned at the winning point; and

(i) evaluating the kind of the symbol positioned at the winning point on the basis of a predetermined kind of symbol for winning.

In the above method, the symbols may be aligned with a line substantially parallel with the first scroll direction, and the second scroll direction is opposite to the first scroll direction.

In the above method, the step (h) may have the step of judging whether the symbol positioned at the winning point is shifted or not on the basis of a predetermined game condition. The step (g) may have the step of determining the number of shifting symbols for shifting the symbols in the second scroll direction on the basis of the predetermined game condition. Furthermore, the step (f) may have the step of determining the number of shifting symbols for shifting the symbols in the first scroll direction on the basis of the number of shifting symbols for shifting the symbols in the second scroll direction in the step (g).

The above method may further comprise the step of allowing the player to input the stop instruction to the game machine.

The above method may further comprise the steps of:

(j) deciding a plan of the result of the game; and

(k) judging whether there is a chance to obtain the result of the game according to the plan decided in the step (j) within the waiting time or not; and

(l) performing the step (i) so that the result of the game accords to the plan decided in the step (j).

In the above method, the plan decided in the step (j) may include a plan of the kind of symbol for evaluating. The step (k) may have the step of judging whether the symbol of the symbol arrangement can be brought to a standstill at the winning point within the waiting time to obtain the symbol according to the plan decided in the step (j) or not. Moreover, the step (h) may have the step of performing the step (g) to change the kind of the symbol in accordance with the plan decided in the step (j) when the judgment is made in the step (k) that the symbol of the symbol arrangement can be brought to a standstill at the winning point within the waiting time to obtain the symbol according to the plan decided in the step (j).

BRIEF DESCRIPTION OF THE DRAWINGS

The feature and advantages of the present invention will become more apparent from the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a first embodiment of the game machine according to the present invention;

FIG. 2 is a perspective view of the reel unit provided for the game machine shown in FIG. 1;

FIG. 3 is a front view of the symbol displaying area of the reel unit panel of the game machine shown in FIG. 1;

FIG. 4 is a schematic front view of the reel unit panel of the game machine shown in FIG. 1;

FIG. 5 is a schematic block diagram showing the configuration of the control unit of the game machine shown in FIG. 1;

FIG. 6 is a flowchart showing the flow of the process of controlling the game machine shown in FIG. 1;

FIG. 7 is a flowchart showing the flow of the reel control process called by the step in the process shown in FIG. 6;

FIG. 8 is a flowchart showing the flow of the payout process of the game machine shown in FIG. 1;

FIG. 9 is a flowchart showing the flow of a main routine of the program executed by the microcomputer of the game machine shown in FIG. 1;

FIG. 10 is a flowchart followed by the steps of the program shown in FIG. 9;

FIG. 11 is a flowchart followed by the steps of the program shown in FIG. 10;

FIG. 12 is a flowchart showing the flow of the first embodiment of the reel stopping process routine called by the step of the program shown in FIG. 10;

FIG. 13 is a schematic diagram of the winning request area stored in the ROM of the game machine shown in FIG. 5;

FIG. 14 is a schematic diagram showing the positions of the symbols of the reels of the game machine shown in FIG. 1 when the last reel is rotating in the first direction and two reels have been stopped rotating;

FIG. 15 is a schematic diagram showing the position of the target symbol in the situation shown in FIG. 14;

FIG. 16 is a schematic diagram showing the positions of the symbols of the reels of the game machine before the last reel is shifting symbols in the second direction after shifting in the first direction;

FIG. 17 is a schematic diagram showing the positions of the symbols of the reels of the game machine after all reels stop rotating;

FIG. 18(a) is a timing chart of the forward rotation of the reel of the game machine shown in FIG. 1;

FIG. 18(b) is a timing chart of the backward rotation of the reel of the game machine shown in FIG. 1;

FIG. 18(c) is a timing chart of the start instruction signal of the game machine shown in FIG. 1;

FIG. 18(d) is a timing chart of the stop instruction signal of the game machine shown in FIG. 1;

FIG. 19 is a flowchart showing the flow of the reel stopping process routine of a second embodiment of the game machine;

FIG. 20 is a flowchart showing the flow of the reel stopping process routine of a third embodiment of the game machine; and

FIG. 21 is a diagram showing the stop condition table for searching the number of additional shifting symbols on the basis of the relationship between the flags and the random number in the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 to 18 of the drawings, there is shown a first preferred embodiment of the game machine according to the present invention.

FIG. 1 is a perspective view of the first embodiment of the game machine exemplified by a slot machine 10. As shown in FIG. 1, the slot machine 10 comprises a housing 10a including a front panel 11. The front panel 11 is provided with a reel unit panel 12, an operation unit 13, a game condition indicating panel 14, a dividend rate display panel 15, a bottom panel 16, a medal payout opening 17, a saucer 18, and a pair of speakers 19a and 19b.

The slot machine 10 has a reel unit 30 housed in the housing 10a and having a plurality of rotatable cylindrical reels 32A, 32B and 32C as shown in FIG. 2. The plurality of the reels 32A, 32B and 32C are independently selectively rotated in first and second directions D1 and D2 about an axis 34 by a plurality of stepping motors 35A, 35B (not shown) and 35C, respectively. The plurality of stepping motors 35A, 35B and 35C have a plurality of shafts (not shown) axially mechanically connected to the reels 32A, 32B and 32C, respectively. The stepping motors 35A, 35B and 35C are designed to independently drive the reels 32A, 32B and 32C, respectively, to rotate at the variable speed per a predetermined minimum rotary angle, e.g., a predetermined step angle.

Each of the reels 32A, 32B and 32C has various kinds of symbols serially arranged in a predetermined order on its surface at even intervals. In this embodiment, each reel has twenty-one pieces of symbols consisting of seven different types, for instance, "bell", "bullet", "cherry", "bar", "7" and so on. Referring to FIG. 3, there is shown a front view of the reel unit panel 12 in which the plurality of reels 32A, 32B and 32C are axially arranged behind the reel unit panel 12 to display their several symbols, represented by the reference character "m", through a plurality of windows 31a, 31b and 31c, respectively. In this embodiment, three symbols are displayed in each windows 31a, 31b and 31c.

In FIG. 2, the reel unit 30 further has a plurality of lamp units 33A, 33B and 33C provided for the reels 32A, 32B and 32C, respectively. Each of the lamp units 33A, 33B and 33C has a plurality of lamps for lighting up a predetermined number of the symbols from behind the symbols, respectively, in order to show the predetermined number of the symbols within each of the windows 31a, 31b and 31c. These windows 31a, 31b and 31c are integrally formed into a symbol displaying area 31 in the reel unit panel 12 as shown in FIG. 3. In this embodiment, each of the lamp units 33A, 33B and 33C has three lamps, so that three pieces of symbols can be displayed on the each of the windows 31a, 31b and 31c. The reel unit panel 12, the reels 32A, 32B and 32C, and the lamp units 33A, 33B and 33C thus constructed can integrally serve as displaying means according to the present invention. The displaying means is controlled by controlling means, which will be described later, to display the symbols movable in predetermined directions within the symbol displaying area 31.

In another embodiment, the displaying means may be constructed by a digital displaying unit, not shown, such as a Liquid Crystal Display unit (LCD), a Cathode Ray Tube display unit (CRT), a plasma display unit and so forth. The digital displaying unit is controlled by a predetermined control unit to produce a digital graphics. The digital displaying unit is operable to display a plurality of symbol arrangements and to scroll part of the symbols of the respective symbol arrangements in predetermined directions in order to simulate the motions of the symbols in every direction.

The graphical symbol may be drawn by a dot pattern on the screen of the digital displaying unit and reproduced to

shift the dot pattern in a predetermined direction to the forward position by a predetermined number of dots in response to every interrupt signals. Thus, the graphical symbol can be moved in various different directions crossed at various different angles.

As shown in FIG. 4, the symbol displaying area 31 has a plurality of prize-winning lines including: a center winning line L1 horizontally extending over the center of the windows 31a, 31b and 31c; a pair of upper and lower winning lines L2A and L2B disposed on upper and lower sides of the center winning line L1 and extending in parallel relationship with the center winning line L1; and a pair of cross winning lines L3A and L3B crossed at oblique angles other and traversing the prize-winning lines L1, L2A and L2B. Each of the prize-winning lines is thus designed to cross one symbol of each of the reels 32A, 32B and 32C within the symbol displaying area 31, thereby having three symbols positioned thereon in total. The combination of three symbols positioned on each of the prize-winning lines is referred to as "three-symbols combination" hereinafter. In another embodiment, the winning line may be replaced with a predetermined winning point.

The slot machine 10 comprises an investing medal number indicating unit 21 for indicating the number of investing medals for the present game by blinking. The investing medal number indicating unit 21 has a plurality of lamps arranged on one side of the symbol displaying area 31 of the reel panel unit 12. The investing medal number indicating unit 21 includes: a lamp 21a disposed on one end side of the center winning line L1 for indicating that one medal is invested in betting for the present game in which the slot machine 10 is operated to evaluate a single three-symbols combination positioned on the center winning line L1; a pair of lamps 21b disposed on one end sides of the upper and lower winning lines L2A and L2B, respectively, for indicating that two medals are invested in betting for the present game in which the slot machine 10 is operated to evaluate two three-symbols combinations positioned on the upper and lower winning lines L2A and L2B, respectively, in addition to one three-symbols combination positioned on the center winning line L1; and a pair of lamps 21c disposed on one end sides of the cross winning lines L3A and L3B, respectively, for indicating that three medals are invested in betting for the present game in which the slot machine 10 is operated to evaluate five three-symbols combinations positioned on five prize-winning lines L1, L2A, L2B, L3A and L3B, respectively.

As shown in FIG. 1, the slot machine 10 further comprises a game condition indicating unit 22 has a plurality of game condition indicators arranged on the other side of the symbol displaying area 31 of the reel panel unit 12 and indicating various game conditions in various game situations. The game condition indicators includes: a medal insertion indicator 22a for indicating that the slot machine 10 is operating under the condition to enable the slot machine 10 to receive the medals therein; a game start indicator 22b for indicating that the slot machine 10 is operating under the condition to enable the slot machine 10 to start rotating the reels; a prize winning indicator 22c for indicating that a prize is won in the present game; a waiting indicator 22d for indicating that the slot machine 10 is operating under the unready condition; and a free game indicator 22e for indicating that the slot machine 10 is operating under the condition to play a free game.

The slot machine 10 further comprises a display unit 23, such as a Liquid Crystal Display unit (LCD), disposed under the reel panel unit 12 for displaying various information on

the game, e.g., the number of credit medals, an expectation of the prize-winning, the number of prize-winning games, the number of pay-out medals, and so on.

The operation unit 13 comprises: a plurality of stop buttons 41a, 41b and 41c arranged under the LCD unit 23 for respectively operating the reels 32A, 32B and 32C to stop rotating; a start lever 42 arranged on the left side of the stop buttons 41a, 41b and 41c for operating all of the reels 32A, 32B and 32C to simultaneously start rotating; a plurality of medal investing buttons 43a, 43b and 43c arranged on the left side of the LCD unit 23 for allowing the player to respectively select one medal, two medals and three medals for investing in betting for the present game; a medal inlet slot 45 for allowing the player to insert the medals one by one by hand to the slot machine 10 therethrough; and a medal inlet port 46 for allowing the player to insert a lot of medals to a container, not shown, in the slot machine. The container is capable of storing therein a large number of medals in order to automatically invest the medals in betting by extracting some medals therefrom. The operation unit 13 further comprises a credit medal settlement button 47 for allowing the player to request the slot machine 10 to pay the credit medals by extracting from a hopper 81, not shown in detailed.

The game condition indicating panel 14 is disposed on the top of the front panel 11 of the slot machine 10 and has a lamp disposed behind the panel for indicating a plurality of different modes in which the slot machine 10 operates. The game condition indicating panel 14 is operated to blink at a plurality of different predetermined blinking interval patterns corresponding to the different modes, respectively. The plurality of different modes may include a prize-winning play mode, a repeatedly prize-winning play mode, an error mode, a play-out mode, a prize-winning expecting mode, a medal withdrawing mode, and so on.

The dividend rate display panel 15 is positioned under the game condition indicating panel 14 and designed to indicate information on the dividend rate for the game in the slot machine 10. For instance, the information may include a list of a plurality of winning combinations for bringing the game to operate under predetermined special game conditions having a high expectation of winning and a high dividend rate, and a list of the number of medals awarded corresponding to each of predetermined winning combinations.

The bottom panel 16 is disposed on the bottom of the front panel 11 of the slot machine 10 and has a name and a model of the slot machine 10 printed thereon. The medal pay-out opening 17 is formed on the lower portion of the front panel 11 for paying out the medals therethrough. The pay-out medals are then received by the saucer 18.

The slot machine 10 thus constructed can allow the player to play the game through the following steps of: allowing the player to invest one to three medals in betting for the present game to cause the prize-winning lines corresponding to the number of the invested medals to be effective by inserting the medal into the slot machine 10 through the medal inlet slot 45 or by selecting one from the medal investing buttons 43a, 43b and 43c; allowing the player to operate the start lever 42 to simultaneously start rotating the reels 32A, 32B and 32C; allowing the player to operate the stop buttons 41a, 41b and 41c to stop rotating the reels 32A, 32B and 32C to bring the symbols of the reels 32A, 32B and 32C, respectively, to a standstill on the effective winning lines to obtain three-symbols combinations corresponding to the effective winning lines; and evaluating the obtained three-symbols combinations and awarding a prize in accordance

with the evaluated result when the three-symbols combinations are worth winning.

Referring to FIG. 5 of the drawings, there is shown a control unit 50 for controlling the slot machine 10. As shown in FIG. 5, the control unit 50 comprises a microcomputer 54 equipped with a Central Processing Unit (CPU) 51, and a Read Only Memory (ROM) 52 for storing therein a predetermined program and data for controlling the slot machine 10, and a Random Access Memory (RAM) 53 for temporary storing therein data and serving as a work area. The control unit 50 further comprises a clock generator 56, a divider 57, a random number generator 58, and a random number sampling circuit 59. The clock generator 56 is designed to generate a base clock pulse.

The divider 57 is electrically connected to the clock generator 56 and designed to input the base clock pulse generated by the clock generator 56 to divide the inputted base clock pulse and then to produce an interrupt signal pulse. The divider 57 is also electrically connected to the microcomputer 54. The produced interrupt signal pulse is then transmitted to the microcomputer 54. The random number generator 58 is electrically connected to the microcomputer 54 and designed to generate a random number. The random number sampling circuit 59 is electrically connected to the random number generator 58 and designed to sample one of the random numbers generated by the random number generator 58 in response to a predetermined instruction signal from the microcomputer 54. The sampled random number is within a predetermined limited range.

In another embodiment, the random number generator 58 and the random number sampling circuit 59 may be replaced with a predetermined random number sampling process carried out by the CPU 51 of the control unit 50 by executing a predetermined program.

The control unit 50 further comprises inputting means for inputting, to the microcomputer 54, various instructions issued by an operator and various control signals transmitted from a host computer (not shown) which is linked with the microcomputer 54. The inputting means is equipped with a group of various sensors including a start switch 61, a medal sensor 62 and a medal invest switch 63. The start switch 61 is electrically connected to the start lever 42 and designed to generate a predetermined start instruction signal in response to the signal transferred from the start lever 42 when the operator operates the start lever 42. The start switch 61 is also electrically connected to the microcomputer 54 and designed to then transfer the start instruction to the microcomputer 54. The start lever 42 serves as scroll starting means in cooperation with the start switch 61 to generate the start instruction signal to allow the microcomputer 54 to instruct the reels 32A, 32B and 32C to simultaneously start to rotate.

The medal sensor 62 is electrically connected to the microcomputer 54 and designed to sense the insertion of the medals through the medal inlet slot 45 and to then inform the microcomputer 54 on the insertion of the medals. The medal invest switch 63 is electrically connected to the medal investing buttons 43a, 43b and 43c and designed to detect which of buttons is operated by the player. The medal invest switch 63 is electrically connected to the microcomputer 54 and designed to inform the microcomputer 54 which of medal investing buttons 43a, 43b and 43c is operated by the player.

The control unit 50 further comprises a motor driving circuit 71, a hopper driving circuit 72, a display driving circuit 73, an audio outputting unit driving circuit 74, an

indicator driving circuit 75, a reel stop signal circuit 76, a reel position sensing circuit 77, and a pay-out signal circuit 78. The microcomputer 54 is electrically connected to these circuits and is operated to control the operations of these circuits for driving various actuators in the slot machine 10 and detect the conditions of these operations.

The motor driving circuit 71 is electrically connected to the stepping motors 35A, 35B and 35C and designed to generate a plurality of motor driving pulses corresponding to the stepping motors 35A, 35B and 35C to then transmit the motor driving pulses to the stepping motors 35A, 35B and 35C, respectively.

In this embodiment, each of the stepping motors 35A, 35B and 35C is the type of a half step driving motor having a plurality of winding coil groups including, for example, four phases A, B, C and D. The phases A, B, C and D of the winding coil group are sequentially driven on in response to the motor driving pulse transmitted every predetermined step time (e.g., 1.88 msec) in a predetermined cyclic order, for instance, the phases A and D are driven on, the phase A is then driven on, the phases A and B are then driven on, the phase B is then driven on, the phases B and C are then driven on, the phase C is then driven on, the phases C and D are then driven on, and the phase D is then driven on. In this sequence, each of the stepping motors 35A, 35B and 35C can be repeatedly rotated at one step angle every step of driving one of the phases, thereby making it possible to cause the corresponding reel continuously rotate in a predetermined direction, for instance the first direction D1. The reel may be rotated in a reverse direction, e.g., the second direction D2, by sequentially driving the winding coil group in reverse cyclic order, i.e., the phases A and D, the phase D, the phases D and C, the phase C, the phases C and B, the phase B, the phases B and A, and the phase A. The microcomputer 54 is operated to control the motor driving circuit 71 to produce the motor driving pulses in order to rotate the stepping motor 35A, 35B and 35C, respectively. The detailed description of this operation will be made later.

The rotation speed of the reel can be regulated by varying the pulse duration of the motor driving pulse. In case of the reel accelerating process, the motor driving circuit 71 is firstly operated to output the motor driving pulse for a first predetermined pulse duration, e.g., 22.56 msec ($=1.88 \times 12$). The motor driving circuit 71 is then operated to output the motor driving pulse for a second predetermined pulse duration, e.g., 13.16 msec ($=1.88 \times 7$). After repeating to output this motor driving pulse predetermined times, the motor driving circuit 71 is operated to repeatedly output the motor driving pulse for a third predetermined pulse duration, e.g., 9.40 msec ($=1.88 \times 5$) predetermined times. Thereafter, the motor driving pulse is repeatedly outputted for a fourth predetermined pulse duration, e.g., 3.76 msec (1.88×2) predetermined times before each reel is rotated at a constant speed. Consequently, the stepping motor can be driven to rotate at the constant speed, while the motor driving pulse is repeatedly outputted for a fifth predetermined pulse duration, e.g., 1.88 msec.

In case of the reel decelerating process, on the other hand, the pulse duration of the motor driving pulse is gradually increased in order to stop rotating the reel.

The hopper driving circuit 72 is electrically connected to the hopper 81. The hopper driving circuit 72 is designed to generate a hopper driving signal in response to a predetermined pay-out request signal transmitted from the microcomputer 54. The hopper driving signal is then outputted to the hopper 81 so that the medals is paid out from the hopper

81 in response to the pay-out request signal. The display driving circuit 73 is electrically connected to the LCD unit 23 and designed to drive the LCD unit 23 to display the various information on the game, e.g., the number of credit medals, an expectation of prize-winning, the number of prize-winning, the number of pay-out medals, and so on.

The audio outputting unit driving circuit 74 is electrically connected to an audio outputting unit, such as the speakers 19a and 19b, and designed to drive the speakers 19a and 19b. The indicator driving circuit 75 is electrically connected to a plurality of back lamps 83, which are provided in the inside of the housing 10a of the slot machine 10, for example, the lamps of the lamp units 33A, 33B and 33C, and the lamp of the game condition indicating panel 14. The indicator driving circuit 75 is designed to operate the back lamps 83 to turn on and off or blink at predetermined intervals according to the aforesaid conditions of the game. The reel stop signal circuit 76 is electrically connected to the stop buttons 41a, 41b and 41c. The reel stop signal circuit 76 is designed to generate a plurality of predetermined stop instruction signals for stopping the rotations of the reels 32A, 32B and 32C in response to the operations of stop buttons 41a, 41b and 41c, respectively. The stop instruction signals are then transmitted to the microcomputer 54. The player may selectively operate the stop buttons 41a, 41b and 41c so that the reels 32A, 32B and 32C, respectively, stop rotating to bring the desired symbols to a standstill on a predetermined position, e.g., the effective prize-winning lines. The stop buttons 41a, 41b and 41c serve as scroll stopping means in cooperation with the reel stop signal circuit 76 to allow the microcomputer 54 to generate the stop instruction signals to instruct the reels 32A, 32B and 32C, respectively, to stop rotating.

The reel position sensing circuit 77 is electrically connected to the reels 32A, 32B and 32C and designed to sense the position of each of the reels 32A, 32B and 32C by calculating a rotary angle on the basis of a predetermined standard position. The reel position sensing circuit 77 is further designed to generate a predetermined reset pulse, when each of the reels 32A, 32B and 32C makes one rotation to transmit to the microcomputer 54.

The pay-out signal circuit 78 is electrically connected to a medal sensing unit 82 (not shown in detail) for sensing that the medal is paid out and outputting a medal sensing signal. The pay-out signal circuit 78 is designed to count the number of the pay-out medals in accordance with the medal sensing signal transmitted from the medal sensing unit 82, and then to output a pay-out completion signal to the microcomputer 54 when the counted number of the pay-out medals exceeds a predetermined number.

The microcomputer 54 thus constructed can operate to control the operations of the circuits, actuators and units, e.g., the stepping motors 35A, 35B and 35C and the display unit 23, in accordance with a predetermined control program stored in the ROM 52 in cooperation with data stored in the ROM 52, and various information including an operation information on the player's operation in accordance with the signals transmitted from the inputting means, such as the switches 61 and an operative condition information sensed by the aforesaid sensors. The ROM 52 contains a predetermined expectation of prize winning table, a predetermined symbol design table, and a predetermined winning combination table including a plurality of predetermined winning combinations of symbols for winning a prize.

The predetermined winning combination may include a big bonus combination and a regular bonus combination

thereby causing the game to enter a predetermined special game condition. The other combination may be a predetermined combination of three of the same symbols, for example, "bell" symbols or "bullet" symbols, thereby causing the game to award several medals. Furthermore, a replay combination causes the game to enter a free game condition. Accordingly, the microcomputer 54 can detect the positions of the symbols of each of the reels on the basis of the rotary angle relative with respect to the standard position transmitted from the reel position sensing circuit 77.

Each of the reels 32A, 32B and 32C is marked with a plurality of position codes spaced at predetermined rotary angle intervals from the predetermined standard position. The predetermined position codes correspond to the positions of the symbols, respectively, in the each of reels 32A, 32B and 32C. The predetermined symbol design table has a relationship between the position codes and a predetermined symbol codes corresponding to the kinds of the symbols stored in the ROM 52.

The predetermined winning combination table further has the number of medals for awarding a prize and a predetermined prize winning judgment codes corresponding to the winning combinations. This winning combination table is thus used for the stop control of the rotations of the reels 32A, 32B and 32C and the judgment for awarding a winning prize.

Referring now to FIGS. 6 to 8 of the drawings, there is shown a method of controlling the game machine according to the present invention.

The above control unit 50 is operable to carry out the following process of controlling the slot machine 10 to allow the player to play the game. The control unit 50 is operated to repeat the steps P1 to P11 shown in FIG. 6 every game cycle. It is assumed that the game cycle begins at the time when the rotation of the reels is started in response to the start instruction and ends at the time when the three-symbols combinations positioned on the effective prize-winning lines are evaluate to award a prize.

In the step P1, the control unit 50 is operated to judge whether the game is required to start or not. The judgment is made on the basis of, for example, the start instruction signal transmitted from the start switch 61. When the answer in the step P1 is "YES", the step P1 proceeds to the step P2. When the answer in the step P1 is "NO", the control unit 50 is operated to wait for the request to start the game in the step P1.

In the step P2, the control unit 50 is operated to decide a plan of the result of the game by selecting one from among various cases previously defined and stored in a predetermined winning expectation table.

This operation of deciding the plan may be generally referred to as "operation of drawing a lottery". The winning expectation table is stored in the ROM 52 and indicative of a relationship between the random numbers and various result cases due to the three-symbols combinations. The result cases of the game include: for example, a first case where the game will failure because that the three-symbols combination is excluded from the prize-winning combinations; a second case where the game will win a small prize due to a predetermined specific symbol combination is gotten; a third case where the game will get a free game in which the player can play the game without investing the medals in betting; a fourth case where the game will get a predetermined bonus game; and so on. For instance, the bonus game has: a big bonus game, referred to as "BB" hereinafter, and a regular bonus game, referred to as "RB"

hereinafter. In the BB game, the player can repeatedly play the games under a big bonus condition having a predetermined high dividend rate and a predetermined high expectation of winning thereby making it possible to successively at a predetermined successive times, e.g., 30 times, win a high prize. In the RB game, the player can play the game under a regular bonus condition having a predetermined high dividend rate and a predetermined high expectation of winning, thereby making it possible to win a high prize. In both of bonus games, the bonus conditions may be assumed after 15 medals are paid out. Under the BB condition, the player may further play a predetermined number of games, e.g., 3 games, under the RB condition.

The control unit 50 is operated to make the random number sampling circuit 59 sample the random number generated by the random number generator 58 at a predetermined timing, for example, when the start switch 61 is operated, and then to look up the winning expectation table stored in the ROM 52 to find the result of the game corresponding to the sampled random number. The plan of the aforesaid game result is thus decided.

In the step P3, the control is passed to a predetermined reel control process wherein the control unit 50 is operated to control the rotary operations of the reels 32A, 32B and 32C so that the symbols of the reels 32A, 32B and 32C can be scrolled within the windows 31a, 31b and 31c, respectively. The detailed description of the reel control process will be made later.

When the control is then returned from the reel control process to the step P3, the step P3 proceeds to the step P4 wherein the control unit 50 is operated to judge whether a predetermined time is passed after starting the rotations of the reels, or not. When the answer in the step P4 is "YES", the step P4 proceeds to the step P10. At this time, all of the reels should have been brought into a standstill already by the reel control process to make the three-symbols combinations corresponding to the effective prize-winning lines displayed on the symbol displaying area 31. When the answer in the step P4 is "NO", the step P4 proceeds to the step P5.

In the step P5, the control unit 50 is operated to judge whether any one of the stop instructions corresponding to the reels 32A, 32B and 32C is received from the reel stop signal circuit 76 or not. When the answer in the step P5 is "YES", the step P5 proceeds to the step P6. When the answer in the step P5 is "NO", the control is returned from the step P5 to the step P3.

In the step P6, the control unit 50 is operated to judge whether there is a chance to obtain the result of the game according to the plan decided in the step P2 or not.

More specifically, the judgment in the step P6 is made whether the present game will end in failure or win on the basis of the kinds of symbols respectively positioned on the effective prize-winning lines when the corresponding reel is stopped rotating in response to the operated stop button. When the judgment is firstly made that the present game will win, the judgment is further made whether the symbols, which will be positioned on the effective prize-winning line, can constitute the decided winning combination or not.

In another embodiment, when the judgment is firstly made that the present game will win, the judgment is further made whether each combination of two symbols, which has been positioned on each effective prize-winning line, can constitute the decided winning combination or not. When the judgment is made that the combination of two symbols can constitute the decided winning combination, the judgment

is further made whether a target symbol of the last rotating reel, which can constitute the decided winning combination in cooperation with the two symbols, can stand still on the effective prize-winning line or not.

This means that the control unit 50 is operated to calculate the position of the target symbol of the last rotating reel to judge whether the target symbol of the last reel is positioned within a predetermined range or not. The predetermined range may be assumed to be a predetermined maximum number of shifting symbols, e.g., 4 columns, deviated from the position on the effective prize-winning line when the stop button is operated to stop the rotation of the last rotating reel. This means that the target symbol of the last reel can be positioned on the effective prize-winning line after forwardly proceeding to the predetermined number of shifting symbols. Probably, the predetermined range may be assumed to be a predetermined rotary angle of the reel corresponding the number of shifting symbols.

In the step P7, the control unit 50 is operated to calculate the number of shifting symbols within the predetermined maximum number of shifting symbols. The control unit 50 is further operated to calculate a first rotary angle at which the reel is rotated in the first direction D1 and a second rotary angle at which the reel is rotated in the second direction D2 on the basis of the number of the shifting symbols. In this embodiment, the second direction D2 is opposite to the first direction D1. In another embodiment, the first and second directions D1 and D2 may cross at a predetermined angle, e.g., a right angle. The rotations at the first and second rotary angle will cause the target symbol of the reel to forwardly proceed to the predetermined number of shifting symbols to stand still on the effective prize-winning line.

In the following step P8, the control unit 50 is operated to allow the corresponding reel to start on the rotation stop operation by performing the reel control process and to rotate at the first rotary angle in the first direction D1 in order to shift the symbol of the reel before the rotation of the reel is completed. In the step P9, the control unit 50 is operated to allow the corresponding reel to further rotate at the second rotary angle in the second direction D2 in order to shift the symbol of the reel. Namely, the target symbol of the reel is slowly returned, if possible, to position at the effective prize-winning line. After the symbol is shifted in the first and second directions D1 and D2 in the steps P8 and P9, the symbol of the reel is shifted at the shifting number in the end. After stopping the reel, the step P9 proceeds to the step P10 wherein the control unit 50 is operated to judge whether all reels have been stopped already or not. When the answer in the step P10 is "YES", the step P10 proceeds to the step P11. When the answer in the step P10 is "NO", the control is returned from the step P10 to the step P3.

In another embodiment, when the number of the stationary reels, each of which has been stopped rotating already, exceeds to a predetermined number of reels, the steps P6 to P9 may be bypassed. The only remaining rotating reels may be stopped to rotate in accordance with the steps P6 to P9.

As shown in FIG. 7, the reel control process, which is called by the process of controlling the slot machine 10 shown in FIG. 6, comprises the steps s1 to s4. In the step s1, the control unit 50 is operated to decide the aforesaid pulse output duration for outputting each motor driving pulses and a count criterion according to a predetermined motor driving table stored in the ROM 52. The count criterion is used in the following step s3 for waiting an interrupt to allow the motor driving circuit 71 to output the motor driving pulses. As described above, the motor driving pulses are provided for

the stepping motors 35A, 35B and 35C, respectively. The description of the representative operation of one of the stepping motors 35A, 35B and 35C will be made hereinafter.

In the step s2, the control unit 50 is operated to input, from the divider 57, the interrupt signal pulse which is obtained by dividing the base clock pulse transmitted from the clock generator 56 and to then count the number of the inputted interrupt signal pulses. In the step s3, the control unit 50 is operated to judge whether the number of the inputted interrupt signal pulses exceeds the count criterion or not. When the answer in the step s3 is "NO", the control unit 50 is operated to wait the number of the inputted interrupt signal pulses to exceed the count criterion. When the answer in the step s3 is "YES", the step s3 proceeds to the step s4 wherein the control unit 50 is operated to transmit a single control pulse to the motor driving circuit 71. The motor driving circuit 71 is then operated to generate the motor driving pulse in response to the control pulse transmitted from the control unit 50, thereby driving the stepping motors 35A, 35B and 35C corresponding to the reels 32A, 32B and 32C having no stop instruction received. The step s4 is completed, the control is returned to the process shown in FIG. 6.

The above reel control process is repeatedly called by the step P3 of the process shown in FIG. 6 to leads to the fact that the reel can be gradually regulated by the pulse duration and the count criterion to reduce or increase in the rotary speed, thereby causing the reels to be accelerated for a first predetermined time, then to be rotated at a constant speed for a second predetermined time, and to be decelerated for a third predetermined time to be finally stopped. In this embodiment, the reel control process is a sub procedure called from the main procedure. In particular, the reel control process may be regularly performed in a multi-task system.

Furthermore, the reel control process may be called by the step P7 of the process shown in FIG. 6 in order to decelerate the reel to stop rotating.

The slot machine 10 is further operated to carry out the following pay-out process of paying out the medals after evaluating the three-symbols combination to obtain the result of the game in the step P11 shown in FIG. 6. The pay-out process comprises the steps Q1 to Q5 as shown in FIG. 8.

In the step Q1, the control unit 50 is operated to output a medal number indicating signal to the display driving circuit 73 to allow the display unit 23 to display the number of awarding medals for winning a prize in accordance with the result of the game obtained in the above process. In the following step Q2, the control unit 50 is operated to output a predetermined instruction signal to the hopper driving circuit 72 to make the hopper 81 pay-out the awarding medals for winning the prize. While the medals are extracted from the hopper 81, the medal sensing unit 82 is operated to sense the medals extracted from the hopper 81 in the step Q3. At the same time, the pay-out signal circuit 78 is operated to count the pay-out medals according the signal inputted from the medal sensing unit 82 in the step Q3. In the step Q4, the pay-out signal circuit 78 is operated to judge whether the counted number of the pay-out medals exceeds to the number indicative of the medal number indicating signal or not. When the answer is "YES" in the step Q4, the step Q4 proceeds to the step Q5. When the answer is "NO" in the step Q4, the control is returned from the step Q4 to the step Q2. The above steps Q2 to Q4 are repeatedly performed to pay-out the medals until the number of the pay-out medals exceeds to the number of the awarding medals.

In the step Q5, the pay-out signal circuit 78 is operated to output the pay-out complete signal to the control unit 50. The control unit 50 is operated to receive the pay-out complete signal transmitted from the pay-out signal circuit 78 and to allow the hopper 81 to stop the pay-out by way of the hopper driving circuit 72. Then the pay-out process is completed.

When the player operates the start lever 42, the start instruction is transmitted to the microcomputer 54 to cause all reels to rotate in the first direction D1. The reels 32A, 32B and 32C are gradually decelerated to stop rotating when a predetermined time is passed after the reel is started to rotate. Before the predetermined time is passed, the stop buttons 41a, 41b and 41c are operated by the player, the stop instructions are transmitted to the microcomputer 54 to cause the rotations of the reels 32A, 32B and 32C, respectively, to be stopped.

At this time, the control unit 50 is operated to determine whether the reel is rotated in the second direction D2 after the reel is stopped rotating in the first direction D1 or not. The control unit 50 can be further operated to calculate the number of shifting symbols on the basis of the position of the symbol of the reel, the plan of the game result, the symbol combination on the effective prize-winning line, and so on.

Referring to FIGS. 9 to 11 of the drawings, there is shown a flowchart of a main routine of a game program of controlling the slot machine 10 executed by the microcomputer 54, so that the aforesaid process of controlling the game machine according to the present invention can be performed. After turning on power to activate the slot machine 10, the microcomputer 54 is firstly operated to check a predetermined memory area and to initialize a predetermined output port and then start a predetermined initializing procedure in the game program of controlling the slot machine 10 to get the slot machine 10 ready for playing the game, not shown.

As shown in FIG. 9, in the step S101, the microcomputer 54 is operated to judge whether there is an automatically investing request or not. The automatically investing request may be generated when the player selectively operates the medal investing buttons 43a, 43b and 43c. Moreover, automatically investing request may be generated when the previous game got the free game. When the answer in the step S101 is "YES", the step S101 proceeds to the step S102 wherein the microcomputer 54 is operated to perform a predetermined investing process of automatically investing the medals corresponding to the requested number of medals in betting corresponding to the selected medal investing buttons 43a, 43b and 43c. When the previous game got the free game, the number of medals may be equal to that of the previous game. The step S102 then proceeds to the step S104.

When the answer in the step S101 is "NO", the step S101 proceeds to the step S103 wherein the microcomputer 54 is operated to wait for the insertion of the medals through the medal inlet port 45. More specifically, when the player inserts one medal to the slot machine 10 through the medal inlet port 45, only the center winning line L1 is made effective in betting. At this time, the investing medal number indicating unit 21a is turned on, thereby allowing the player to recognize this line to be effective in betting. When the player inserts two medals to the slot machine 10 through the medal inlet port 45, the upper and lower winning lines L2A and L2B are made effective in betting in addition to the center winning line L1. At this time, the investing medal

number indicating unit 21b as well as 21a are turned on, thereby allowing the player to recognize these lines to be effective in betting. When player inserts three medals to the slot machine 10 through the medal inlet port 45, all of the winning lines L1, L2A, L2B, L3A and L3B are made effective in betting. At this time, all of the investing medal number indicating units 21a, 21b and 21c are turned on, thereby allowing the player to recognize these lines to be effective in betting.

In the step S103, the number of medals for betting is limited to three medals in a normal game playing, while the number of medals for betting is limited to one medal in a RB game playing. The microcomputer 54 is operated to perform another predetermined investing process of investing the inserted medals in betting for the present game. Then the step S103 proceeds to the step S104.

In the step S104, the microcomputer 54 is operated to judge whether the start lever 42 is operated or not on the basis of the predetermined input signal transmitted from the start switch 61. When the answer in the step S104 is "YES", the step S104 proceeds to the step S105. The microcomputer 54 is operated to wait in the step S104 until the player operates the start lever 42.

In the step S105, the microcomputer 54 is operated to sample a single random number for the operation of drawing a lottery from the random number sampling circuit 59 as described above. The sampled random number is temporarily stored in the RAM 53 in order to be used for decision on a plan of the result of the game in the later step S108.

In the step S106, the microcomputer 54 is operated to judge whether a predetermined waiting time is passed after starting the previous game or not. When the answer in the step S106 is "YES", the step S106 proceeds to the step S108. When the answer in the step S106 is "NO", the step S106 proceeds to the step S107 wherein the microcomputer 54 is operated to wait until the predetermined waiting time, for example, 4.1 msec, is passed after starting the previous game. The step S107 proceeds to the step S108, when the predetermined waiting time is over.

In the step S108, the microcomputer 54 is operated to look up the winning expectation table to find out the result of the present game in accordance with the random number stored in the RAM 53 in the step 105. The predetermined winning expectation table is previously stored in the ROM 52 as described above. On the basis of the obtained result, the microcomputer 54 is operated to have a plurality of predetermined flags respectively set or reset. These flags are temporarily stored in a predetermined winning request area in the RAM 53. In response to the set of the respective flags in the winning request area, a predetermined winning request signal corresponding to the set flag is generated.

More specifically, the microcomputer 54 is operated to judge whether the sampled random number is included within a predetermined prize-winning range of the winning expectation table or not. When the judgment is made that the sampled random number is included within the predetermined prize-winning range of the winning expectation table, the microcomputer 54 is then operated to set the corresponding flag to produce the winning request signal. When, on the other hand, the judgment is made that the sampled random number is excluded from the predetermined prize-winning range of the winning expectation table, the microcomputer 54 is then operated to reset the corresponding flag.

Referring to FIG. 13, there is shown an example of the winning request area A1 including six flags, for example, "failure" indicative that the game will be failure, "bullet"

indicative that the game will get the combination of three bullet symbols, "bell" indicative that the game will get the combination of three bell symbols, "free game" indicative that the game will get the free game, "RB" indicative that the game will get the RB game, and "BB" indicative that the game will get the BB game, when respective these flags are set to "1". In case of FIG. 13, the bell flag is set to "1" wherein the game will be get the combination of three bell symbols.

As described above, at the time of detecting the start operation in the step S104, the slot machine 10 is operated to perform the reel rotating process when the start lever 42 is operated. The CPU 51 is operated to output a predetermined control signal, such as the motor driving pulse, to the motor driving circuit 71 in response to the predetermined start instruction signal transmitted from the start switch 61 by sensing the operation of the start lever 42. The motor driving circuit 71 is operated to drive the stepping motors 35A, 35B and 35C to have the reels 32A, 32B and 32C, respectively, rotated.

The reel rotating process is performed by the microcomputer 54 in the following steps S109 to S111 in FIG. 9. In the step S109, the microcomputer 54 is operated to perform a predetermined initialization process to start rotating the reels 32A, 32B and 32C. The step S109 proceeds to the step S110 wherein the aforesaid reel rotating process is performed to start and accelerate the rotation of the reels 32A, 32B and 32C.

More specifically, the microcomputer 54 is operated to accelerate the rotation of the reels 32A, 32B and 32C at a predetermined degree, i.e., at variable speed increased in accordance with a predetermined rate pitch. After the reels 32A, 32B and 32C have been rotated at a predetermined constant speed, the microcomputer 54 is operated to control the reels 32A, 32B and 32C to rotate at the constant speed.

In the reel rotating process, the microcomputer 54 is further operated to count the motor driving pulses supplied to each of the stepping motors 35A, 35B and 35C after starting the rotations of the reels 32A, 32B and 32C. The microcomputer 54 is then operated to temporarily store the counts of the respective reels 32A, 32B and 32C in the RAM 53. At the same time, the CPU 51 is operated to input the predetermined reset pulses of each of the reels 32A, 32B and 32C transmitted from the reel position sensing circuit 77 to clear the stored counts corresponding to the reels 32A, 32B and 32C, respectively, to zero. Accordingly, the positions of the rotating reels 32A, 32B and 32C can be represented as the counts of the reels 32A, 32B and 32C per the total counts of one rotation.

In the step S111, the microcomputer 54 is operated to judge whether the rotating speed of each of the reels 32A, 32B and 32C exceeds to the predetermined constant speed or not. The predetermined constant speed may be a first rotating speed indicative of r1 (rotation counts/min). When the answer in the step S111 is "YES", the step S111 proceeds to the step S112 shown in FIG. 10. When the answer in the step S112 is "NO", the control is returned from the step S111 to the step S110. Thus, the reels 32A, 32B and 32C are accelerated at the predetermined degree until the rotating speed of the reels 32A, 32B and 32C exceeds to the constant speed, after starting the rotate of the reels 32A, 32B and 32C. When the rotating speed of the reels 32A, 32B and 32C exceeds to the constant speed, the operations of the stop buttons 41a, 41b and 41c are then enabled.

As shown in FIG. 10, the microcomputer 54 is then operated to judge whether any one of the stop buttons 41a,

41b and 41c is pushed by the player or not in the step S112, and further judge whether a predetermined reel operating time, e.g., 40 sec, is passed after starting the rotate of the reels or not in the step S113. The judgment is made in the step S113 by judging whether a predetermined auto-stop timer for automatically counting the predetermined reel operating time down to zero is set after starting the rotation and counts down to zero or not. When the answer in either the step S112 or S113 is "YES", the control goes to the step S114 wherein a predetermined reel stopping process routine is called. When the answer in both the step S112 and S113 are "NO", the control is returned from the step S113 to the step S112. The description of the reel stopping process routine called by the step S114 will be made later.

The control is then returned from the reel stopping process routine to the step S120 wherein the microcomputer 54 is operated to set a predetermined reel stop requests for the reels 32A, 32B and 32C corresponding to the pushed stop button 41a, 41b and 41c, respectively. In the step S121, the microcomputer 54 is operated to judge whether all of the reels 32A, 32B and 32C are stopped or not. This judgment is not only made by checking whether all of the reels 32A, 32B and 32C have been entirely stopped or not, but also checking whether the reel stop requests are set or not before the reels have been entirely stopped. When the answer in the step S121 is "YES", the step S121 proceeds to the step S122 shown in FIG. 11. When the answer in the step S121 is "NO", the control is returned from the step S121 to the step S112. In this case, the slot machine 10 is operated to repeat the process including the step S112 to S121 until the judgment in the step S121 is made "YES".

As shown in FIG. 11, in the step S122, the microcomputer 54 is operated to evaluate the three-symbols combinations respective positioned on the effective winning lines by searching various predetermined winning combinations. The microcomputer 54 is operated to decide the number of medals for awarding a prize according to the kind of winning combinations.

In the following step S123, the microcomputer 54 is operated to judge whether there is no medal for awarding a prize or not. When the answer in the step S123 is "YES", the step S123 proceeds to the step S125. When the answer in the step S123 is "NO", the step S123 proceeds to the step S124 wherein the microcomputer 54 is operated to select the method of paying out medals from among the methods of: reserving the pay-out medal for the credit; and particularly paying out medals outside. This selection of the pay-out method is previously determined in accordance with a predetermined mode selecting button, such as a dip switch, not shown and included in the slot machine 10.

In the step S125, the microcomputer 54 is operated to judge whether the slot machine 10 operates under the RB game condition or not. When the answer in the step S125 is "YES", the step S125 proceeds to the step S127 wherein a predetermined RB game playing process is performed. When the answer in the step S125 is "NO", the step S125 proceeds to the step S126 wherein the microcomputer 54 is operated to judge whether the slot machine 10 operates under the BB game condition or not. When the answer in the step S126 is "YES", the step S126 proceeds to the step S128 wherein a predetermined BB game playing process is performed. When the answer in the step S126 is "NO", i.e., the slot machine 10 operates under the normal game condition except both of BB and RB game conditions, the step S126 proceeds to the step S129 wherein the microcomputer 54 is operated to judge whether the present game win a prize for BB game or not. When the answer in the step S129 is "YES",

the step S129 proceeds to the step S130. When the answer in the step S129 is "NO", the step S129 proceeds to the step S131 wherein the microcomputer 54 is operated to judge whether the present game win a prize for RB game or not. When the answer in the step S131 is "YES", the step S131 proceeds to the step S132. When the answer in the step S131 is "NO", the step S131 proceeds to the step S133. In the steps S130 and S132, the microcomputer 54 is operated to set predetermined BB and RB enable flags to "1", respectively. In response to the enabled BB and RB enable flags, the microcomputer 54 is operated to initialize various information on the BB and RB games in predetermined data areas, thereby causing the slot machine 10 can operate under the BB and RB game conditions, respectively. The steps S127, S128, S130 and S132 then proceed to the step S135.

When the judgments in both of step S129 and S131 are made that no bonus game is gotten, the microcomputer 54 is operated to judge whether the present game win a prize for the free game or not in the step S133. When the answer in the step S133 is "YES", the step S133 proceeds to the step S134 wherein the microcomputer 54 is operated to set a free game request flag. In response to the request made by setting the free game request flag, the microcomputer 54 is operated to request the automatically inventing medal for the free game. When the answer in the step S133 is "NO", the step S133 proceeds to the step S135 wherein the microcomputer 54 is operated to set a flag indicative that a single game routine is completed.

Referring to FIG. 12 of the drawings, there is shown a first example of the reel stopping process routine of controlling to stop the rotation of the reels. As shown in FIG. 12, the reel stopping process routine comprises the steps S151 to S156.

In the step S151, the microcomputer 54 is operated to calculate the number of shifting symbols. The number of shifting symbols is determined on the basis of the various information including: the flags in the winning request area; the value read out from a predetermined refresh register (R-register) when each stop button is operated; the present positions of the reels (or the positions of the target symbols) and so on. The number of shifting symbols is defined as the number of symbols which can be shifted to have the target symbol positioned on the effective prize-winning line within a predetermined time duration, e.g., 190 msec, provided for in the present law, after detecting the stop operation for the reel. In case when the symbols are shifted only in the first direction D1, the number of shifting symbols may be limited to four symbols. The R-register is designed to refresh data in the register cyclically varied from 0 to a predetermined value at high speed.

In the following step S152, the microcomputer 54 is operated to judge whether the target symbol for the winning combination can be stopped on the effective prize-winning line or not. This judgment is made on the basis of the flags in the winning request area, i.e., whether any one of the flags including the three "bell" or "bullet" symbols combination flag, the RB game flag, and the BB game flag are set or not. When the answer in the step S152 is "YES", the step S152 proceeds to the step S153. When the answer in the step S152 is "NO", the step S152 proceeds to the step S154.

In the step S153, the microcomputer 54 is operated to add a predetermined additional value, e.g., one, to the number of shifting symbols. In the following step S154, the microcomputer 54 is operated to perform the reel stopping process wherein the reel is rotated in the first direction D1 to shift the symbol of the reel on the basis of the number of shifting symbols obtained in the step S152 or S153.

In the following step S155, the microcomputer 54 is operated to judge whether the addition of the number of shifting symbols is performed in the step S153 or not. When the answer in the step S155 is "YES", the step S155 proceeds to the step S156. When the answer in the step S155 is "NO", the control is returned to the main routine. In the step S156, the microcomputer 54 is operated to perform the reel stopping process wherein the reel is rotated in the second direction D2 to shift the symbol of the reel on the basis of the predetermined additional value for adding the number of shifting symbols. After rotating the symbols in the first and second directions D1 and D2 in the steps S154 and S156, the target symbol of the reel is brought to a standstill on the effective prize-winning line to decide the three-symbols combination.

The description of the operation of the slot machine 10 in accordance with the game program shown in FIGS. 9 to 12 will be made hereinafter.

The microcomputer 54 is operated to start to execute the game program after performing the predetermined initializing procedure as described above. When the player inserts three medals into the slot machine 10 through the medal inlet port 45, there is no investing request. The judgment is made in the step S101, shown in FIG. 9, that there is no automatically investing request, therefore, the step S101 proceeds to the step S103 wherein all of the investing medal number indicating units 21a, 21b and 21c are lighted up and the investing medal number is set to three, i.e., all of prize-winning lines are effective in betting.

When the player operates the start lever 42, the step S104 proceeds to the step S105 wherein a single random number for the operation of drawing a lottery is sampled from the random number sampling circuit 59 and then the sampled random number is temporarily stored in the RAM 53.

When 4.1 seconds have been passed after starting the previous game, the plan of the result of the present game is found out by looking up the winning expectation table in accordance with the random number stored in the RAM 53 in the step S105.

The plan of the game result corresponding to sampled random number is assumed that the winning combination will get the combination consisting of three "bell" symbols. In this case, the "bell" flag of the winning request area A1 is set to "1", the other flags are reset to "0" as shown in FIG. 13, and then the winning request area A1 is stored in the RAM 53. In response to this operation, the winning request signal is generated.

When the player operates the start lever 42, the reel rotating process is performed to make all reels 32A, 32B and 32C rotated in the first direction D1 and accelerated at the predetermined degree in the steps S109 and S110. When the rotating speed of each of the reels 32A, 32B and 32C exceeds to the predetermined constant speed, the step S111 proceeds to the step S112 shown in FIG. 10 wherein the operations of the stop buttons 41a, 41b and 41c becomes to be enabled.

Firstly, The player operates the stop button 41a, thereby calling the reel stopping routine in FIG. 12. In the step S151, the number of shifting symbols is calculated. In this case, if possible, the reel 32A is controlled to stop rotating so that the target symbol for winning combination, i.e., "bell" symbol, will be placed on either one of the effective winning lines due to the winning request signal. It is assumed that the target symbol can be stopped on the winning line L2A. The judgment is made in the step S152 that the target symbol for winning combination can be stopped on the effective win-

ning lines, thereby causing the step S152 to proceed to the step S153. In the step S153, one is added to the number of the shifting symbols. Then the step S153 proceeds to the step S154, the reel 32A is controlled to make the target symbol shift in the first direction D1 before stopping the forward rotation of the reel 32A. The step S154 further proceeds to the step S156 by way of the step S155. In the step S156, the reel 32A is controlled to further rotate backward thereby making the target symbol shift in the second direction D2. Consequently, the "bell" symbol is placed on the winning line L2A as shown in FIG. 14 after shifting the symbol of the reel 32A in the reverse direction. Here, the symbols "o" denotes the "bell" symbols in FIG. 14.

If the judgment is made in the step S152 that the target symbol for winning symbol can not be stopped on the effective winning lines, the steps S153 and S156 are bypassed, so that the reel 32A is controlled to stop rotating without process of shifting the symbols in reverse direction.

After completing the reel stopping process routine, the control is returned to the step S120 of the main routine shown in FIG. 10. The reel stop request corresponding the reel 32A is then set in the step S120. By way of the step S121, the operation of the stop buttons is waited in the step S112.

Next, the player operates the stop button 41b, thereby bringing the rotation of the reel 32B to a standstill by way of the same processes as described above. It is assumed that the "bell" symbol "o" is also placed on the winning line L2A, as shown in FIG. 14, after the symbol of the reel 32B is shifted in the reverse direction.

After completing the reel stopping process routine, the control is returned to the step S120 of the main routine shown in FIG. 10. The reel stop request corresponding the reel 32B is then set in the step S120. By way of the step S121, the operation of the stop buttons is waited in the step S112.

After the two "bell" symbols "o" of the reels 32A and 32B are positioned on the effective winning line L2A as shown in FIG. 14, the player operates the stop button 41c to stop rotating the reel 32C. At this time, the step S112 proceeds to the step S114 wherein the reel stopping process routine is called. In the reel stopping process routine shown in FIG. 12, the number of shifting symbols is calculated in the step S151. It is assumed that the target symbol, i.e., "bell" symbol "o", of the reel 32C is placed at the position behind three columns from that of symbol "A" as shown in FIG. 15 when the stop button 41c is operated by the player. The number of shifting symbols is set to three in the step S151 in order to control the reel 32C to have the target symbol "o" positioned on the effective winning lines.

Accordingly, the judgment is made in the step S152 that the target symbol can be stopped on the effective winning line L2A. Then one is added to the number of shifting symbols in the step S153. Consequently, the number of shifting symbols is set to four. The reel 32C is then controlled in the step S154 to shift the symbol "A" to the position over the number of shifting symbols, i.e., four columns, so that the reel 32C can stop the forward rotation after running the target symbol "o" over the effective prize-winning line L2A as shown in FIG. 16. Immediately, the reel 32C is controlled in the step S156 to start the backward rotation to shift the target symbol "o" in the second direction D2 to the position on the winning line L2A. Thus, the three "bell" symbols are positioned on the effective winning line L2A after stopping the rotation of all reels as shown in FIG. 17.

After completing the reel stopping process routine, the control is returned to the step S120 of the main routine shown in FIG. 10. The reel stop request corresponding to the reel 32C is then set in the step S120. Because that all of the reels 32A, 32B and 32C are stopped, the step S121 proceeds to the step S122 wherein the combinations of symbols positioned on the effective winning lines, in this case all winning lines L1, L2A, L2B, L3A and L3B, are evaluated.

Because that the three "bell" symbols are positioned on the winning line L2A to form the winning combination, the present game win a prize. Therefore, the step S123 proceeds to the step S125. In the judgments made in the following steps S125, S126, S129 and S131, all of the answers are "NO". Therefore, the step S125 proceeds to the step S135 wherein the flag indicative that a single game is completed.

The player can continuously play the game, when the main routine of the program of controlling the game machine is repeatedly recalled.

Referring to FIGS. 18(a) to 18(d), there is shown a timing chart of the above operation of the reels. In response to the operation of the start lever 42, the start instruction signal is set to "1" as shown in FIG. 18(c). When the edge of the risen start instruction signal is detected, the reels 32A, 32B and 32C being to forwardly rotate in the first direction D1 as shown in FIG. 18(a). When the stop button 41c is operated to allow the reel stop signal circuit 76 to generate the stop instruction signal corresponding to the reel 32C, the edge of the stop instruction signal is detected as shown in FIG. 18(d). In response to this detection, the number of the shifting symbols is calculated and the judgment is made whether the backward rotation should be performed or not. When the judgment is made that the backward rotation should not be performed, the reel 32C is controlled to stop rotating in the first direction D1 to bring the target symbol to a standstill after the target symbol passes over the effective prize-winning line.

When the judgment is made that the backward rotation should be performed, the reel 32C is controlled to stop rotating in the first direction D1 to bring the symbol to a standstill on the winning line after the symbol is shifted in the first direction D1 to the columns corresponding to the number of the shifting symbols. In FIG. 18(a), the controlling time duration T1 is variable in accordance with the number of shifting symbols. The sum of the controlling time duration T1 and the over-run and stop operating time duration T2 is indicative of the predetermined time duration for shifting the symbols, e.g., 190 msec. When a predetermined time, e.g., one to several seconds, included in the over-run and stop operating time duration T2 has been passed after stopping the forward rotation of the reel 32C, the reel 32C is controlled to slowly backwardly rotate, i.e., rotate in the second direction D2 to shift the target symbol back to one column thereby causing the target symbol to position on the effective prize-winning line.

It will be understood from the aforementioned description that the game machine according to the present invention has an advantage over the prior art in that the game machine can attract to the player because that the target symbol for winning combination is returned from over-running position to the effective prize-winning line to win the present game, after the player considers that the player fails in the winning in the present game. Accordingly, the player can maintain a high expectation of winning until all reels are completely stopped rotating. The game machine can therefore greatly excite the player just before the game result is determined.

Furthermore, the player having the enormous skill can enjoy the game because that the reel stopping process can be

performed under various conditions determined on the basis of the operations of the player to bring the game to win a big prize in the game machine according to the present invention.

Referring now to FIG. 19 of the drawings, there is shown a second embodiment of the reel stop routine according to the present invention. In the second embodiment, the slot machine may comprise the same constitutional elements as those of the first embodiment except this reel stop routine stored in the ROM 52 and executed by the microcomputer 54.

In the step S251, the microcomputer 54 is operated to calculate the number of shifting symbols. The number of shifting symbols is determined on the basis of the various information including: the flags in the winning request area; the value read out from a predetermined R-register when each stop button is operated; the present positions of the reels (or the positions of the target symbols) and so on. The number of shifting symbols is defined as the number of symbols which can be shifted to have the target symbol positioned on the effective prize-winning line within a predetermined time duration, e.g., 190 msec, provided for in the present law, after detecting the stop operation for the reel. In case when the symbols are shifted only in the first direction D1, the number of shifting symbols may be limited to four symbols. The R-register is designed to refresh data in the register cyclically varied from 0 to a predetermined value at high speed.

In the following step S252, the microcomputer 54 is operated to judge whether the target symbol for the winning combination can be stopped on the effective prize-winning line or not. This judgment is made on the basis of the flags in the winning request area, i.e., whether any one of the flags including the three "bell" or "bullet" symbols combination flag, and the bonus flags having the RB game flag and the BB game flag, are set or not. When the answer in the step S252 is "YES", the step S252 proceeds to the step S253. When the answer in the step S252 is "NO", the step S252 proceeds to the step S256.

In the step S253, the microcomputer 54 is operated to judge whether the bonus flag is set or not. When the judgment is made that the bonus flag is set, the step S253 proceeds to the step S254 wherein the microcomputer 54 is operated to add a predetermined additional value, e.g., two, to the number of shifting symbols. When, on the other hand, the judgment is made that the bonus flag is reset, the step S253 proceeds to the step S255 wherein the microcomputer 54 is operated to add a predetermined additional value, e.g., one, to the number of shifting symbols. The steps S254 and S255 proceed to the step S256 wherein the microcomputer 54 is operated to perform the reel stopping process wherein the reel is rotated in the first direction D1 to shift the symbol of the reel on the basis of the number of shifting symbols obtained in the step S251, S254 or S255. The reel is thus controlled in the step S256 to shift the target symbol to the position proceeding over the effective prize-winning line to one or two columns ahead.

In the following step S257, the microcomputer 54 is operated to judge whether the addition of the number of shifting symbols is performed in the step S254 or S255 or not. When the answer in the step S257 is "YES", the step S257 proceeds to the step S258. When the answer in the step S257 is "NO", the control is returned to the main routine. In the step S258, the microcomputer 54 is operated to perform the reel stopping process wherein the reel is rotated in the second direction D2 to shift the symbol of the reel on the

basis of the predetermined additional value for adding the number of shifting symbols. After rotating the symbols in the first and second directions D1 and D2 in the steps S256 and S258, the symbol of the reel is brought to a standstill on the effective prize-winning line to decide the three-symbols combination.

The slot machine 10 thus constructed can attract to the player because that the target symbol for winning combination is returned from over-running position to the effective prize-winning line to win the present game, after the player considers that the player fails in the winning in the present game. Accordingly, the player can maintain a high expectation of winning until all reels are completely stopped rotating. The slot machine 10 can therefore greatly excite the player just before the game result is determined.

Furthermore, the player having the enormous skill can enjoy the game because that the reel stopping process can be performed under various conditions determined on the basis of the operations of the player to bring the game to win a big prize in the game machine according to the present invention. Particularly, when the present game wins the BB game, the number of shifting symbols is larger than that of the normal game. Therefore, the player can maintain a higher expectation of winning and be greatly excited.

Referring now to FIG. 20 of the drawings, there is shown a third embodiment of the reel stop routine according to the present invention. In the third embodiment, the slot machine may also comprise the same constitutional elements as those of the first embodiment except this reel stop routine stored in the ROM 52 and executed by the microcomputer 54.

In the step S351, the microcomputer 54 is operated to read out the random number from a predetermined R-register. The R-register is designed to refresh data in the register cyclically varied from 0 to 127 at high speed to be able to produce 128 kinds of random numbers. In the step 352, the microcomputer 54 is operated to calculate the number of shifting symbols. The number of shifting symbols is determined on the basis of the various information including: the conditions of the flags in the winning request area; the value read out from the data of the R-register in the step S351 when each stop button is operated; the present positions of the reels (or the positions of the target symbols) and so on.

In the following step S353, the microcomputer 54 is operated to judge whether the target symbol for the winning combination can be stopped on the effective prize-winning line or not. This judgment is made on the basis of the conditions of the flags in the winning request area, i.e., whether any one of the flags including the three "bell" or "bullet" symbols combination flag is set or not, and whether the bonus flags having the RB game flag and the BB game flag are set or not. When the answer in the step S353 is "YES", the step S353 proceeds to the step S354. When the answer in the step S353 is "NO", the step S353 proceeds to the step S356.

In the step S354, the microcomputer 54 is operated to determine the number of additional shifting symbols on the basis of the random number obtained in the step S351. More specifically, the judgment is made by searching a predetermined stop condition table R1 including an R-register value list as shown in FIG. 21. The stop condition table R1 may be indicative of a relationship between the random number ranges and the conditions of the flags in the winning request area, i.e., the previously decided plan of the game result, in order to obtain the number of additional shifting symbols. In this embodiment, the number of additional shifting symbols consists of 0, 1 and 2. For instance, when the three "bell"

symbols combination is requested according to the conditions of the flags in the winning request area, the random number extracted from the R-register is grouped into three ranges consisting of 0-50, 51-120 and 121-127. When the random number ranges between 0 and 50, the number of additional shifting symbols is assumed to be 0. When the random number ranges between 51 and 120, the number of additional shifting symbols is assumed to be 1. When the random number ranges between 121 and 127, the number of additional shifting symbols is assumed to be 2.

When, on the other hand, the BB game is requested according to the conditions of the flags in the winning request area, the random number extracted from the R-register is grouped into three ranges consisting of 0-10, 11-40 and 41-127. When the random number ranges between 0 and 10, the number of additional shifting symbols is assumed to be 0. When the random number ranges between 11 and 40, the number of additional shifting symbols is assumed to be 1. When the random number ranges between 41 and 127, the number of additional shifting symbols is assumed to be 2.

The step S354 proceeds to the step S355 wherein the microcomputer 54 is operated to add the number of additional shifting symbols, which is obtained in the step S354, to the number of shifting symbols calculated in the step S352. The step S355 proceeds to the step S356 wherein the microcomputer 54 is operated to perform the reel stopping process wherein the reel is decelerated and rotated in the first direction D1 to shift the symbol of the reel on the basis of the number of shifting symbols obtained in the step S353 or S355 before the reel is completely stop rotating within a predetermined waiting time. The reel is thus controlled in the step S356 to shift the target symbol to the position proceeding over the effective prize-winning line to one or two columns ahead.

In the following step S357, the microcomputer 54 is operated to judge whether the addition of the number of shifting symbols is performed in the step S355 or not. When the answer in the step S357 is "YES", the step S357 proceeds to the step S358. When the answer in the step S357 is "NO", the control is returned to the main routine. In the step S358, the microcomputer 54 is operated to perform the reel stopping process wherein the reel is rotated in the second direction D2 to shift the symbol of the reel on the basis of the number of additional shifting symbols. After rotating the symbols in the first and second directions D1 and D2 in the steps S356 and S358, the symbol of the reel is brought to a standstill on the effective prize-winning line to decide the three-symbols combination.

The slot machine 10 thus constructed can attract to the player because that the target symbol for winning combination is returned from over-running position to the effective prize-winning line to win the present game, after the player considers that the player fails in the winning in the present game. Accordingly, the player can maintain a high expectation of winning until all reels are completely stopped rotating. The slot machine 10 can therefore greatly excite the player just before the game result is determined.

Furthermore, the player having the enormous skill can enjoy the game because that the reel stopping process can be performed under various conditions determined on the basis of the operations of the player to bring the game to win a big prize in the game machine according to the present invention.

In the aforesaid embodiments, the game machine according to the present invention is exemplified in the slot

machine. In another embodiment, the game machine according to the present invention may be another game machine including a ball shooting game machine, such as a pachinko, or a video game, which has functions of the game machine according to the present invention.

In the above embodiments, the predetermined program may be written by an appropriate programming language. Then a plurality of the program files and data files are converted to an execute format and stored in a nonvolatile storage device, such as PROM (programmable read only memory), EPROM (erasable programmable read only memory), EEPROM (electrically erasable and programmable ROM), CD-ROM, DVD-ROM and so on. In this embodiment, the ROM 52 may be mounted on a circuit board, not shown, in the control unit 50. The ROM 52 can be removed from the circuit board, thereby making it possible to modify the program and data stored in the ROM 52 with ease. Preferably, the circuit board may be also removed from the control unit 50 to be able to modify and repair the circuit board. Alternatively, the program and data stored in the EPROM may be modified and repaired from the host computer by remote operation.

It will be apparent to those skilled in the art and it is contemplated that variations and/or changes in the embodiments illustrated and described herein may be without departure from the present invention. Accordingly, it is intended that the foregoing description is illustrative only, not limiting, and that the true spirit and scope of the present invention will be determined by the appended claims.

What is claimed is:

1. A game machine for allowing a player to play a game comprising:

displaying means capable of displaying a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order;

scrolling means for allowing said displaying means to display part of said symbols of said respective symbol arrangements on a window having a predetermined winning line crossing over said symbol of said respective symbol arrangements to define said symbols positioned on said winning line as a symbol combination and to scroll said symbols of said symbol arrangements within said window in two different predetermined scroll directions including first and second scroll directions;

scrolling starting means for allowing said scrolling means to start to scroll said symbols of said symbol arrangements within said window in said first scroll direction in response to a predetermined start instruction;

receiving means for receiving a plurality of stop instructions corresponding to said plurality of symbol arrangements;

scroll stopping means for allowing said scrolling means to independently stop scrolling said symbols of said symbol arrangements in response to said plurality of stop instructions, respectively, received by said receiving means to bring the symbol of said corresponding symbol arrangements to a standstill on said winning line to obtain said symbol combination after all of said symbols are stopped scrolling;

shifting means for allowing said displaying means to shift said symbols of said symbol arrangements in said first and second scroll directions within a predetermined waiting time after said stop instruction, respectively, are received by said receiving means to change said symbol combination; and

evaluating means for evaluating said symbol combination on the basis of a predetermined winning combination for winning;

wherein said shifting means is operated to judge whether the symbol of each of said symbol arrangements positioned on said winning line is shifted or not on the basis of a predetermined game condition, to determine the number of shifting symbols of each of said symbol arrangements for shifting said symbols in said second scroll direction on the basis of said predetermined game condition, and to determine the number of shifting symbols of each of said symbol arrangements for shifting said symbols in said first scroll direction on the basis of said number of symbols of each symbol arrangements for shifting said symbols in said second scroll direction.

2. A game machine for allowing a player to play a game comprising:

displaying means capable of displaying a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order;

scrolling means for allowing said displaying means to display part of said symbols of said respective symbol arrangements on a window having a predetermined winning line crossing over said symbol of said respective symbol arrangements to define said symbols positioned on said winning line as a symbol combination and to scroll said symbols of said symbol arrangements within said window in two different predetermined scroll directions including first and second scroll directions;

scrolling starting means for allowing said scrolling means to start to scroll said symbols of said symbol arrangements within said window in said first scroll direction in response to a predetermined start instruction;

receiving means for receiving a plurality of stop instructions corresponding to said plurality of symbol arrangements;

scroll stopping means for allowing said scrolling means to independently stop scrolling said symbols of said symbol arrangements in response to said plurality of stop instructions, respectively, received by said receiving means to bring the symbol of said corresponding symbol arrangements to a standstill on said winning line to obtain said symbol combination after all of said symbols are stopped scrolling;

shifting means for allowing said displaying means to shift said symbols of said symbol arrangements in said first and second scroll directions within a predetermined waiting time after said stop instruction, respectively, are received by said receiving means to change said symbol combination;

evaluating means for evaluating said symbol combination on the basis of a predetermined winning combination for winning; and

deciding means for previously deciding a plan of the result of said game;

wherein said shifting means being operated to judge whether there is a chance to obtain the result of said game according to said plan decided by said deciding means within said waiting time or not, and to shift said symbol in said first and second scroll directions so that the result of said game accords to said plan decided by said deciding means.

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3. The game machine as set forth in claim 2, in which said plan decided by said deciding means includes a plan of said symbol combination for evaluating, and said shifting means is operated to judge whether the symbols of said symbol arrangement can be brought to a standstill on said winning line within said waiting time to obtain said symbol combination according to said plan decided by said deciding means or not, and to shift said symbol in said first and second scroll directions to change said symbol combination in accordance with said plan decided by said deciding means when the judgment is made that the symbols of said symbol arrangement can be brought to a standstill on said winning line within said waiting time to obtain said symbol combination according to said plan decided by said deciding means.

4. A method of controlling a game machine for allowing a player to play a game comprising the steps of:

- (a) forming a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order;
- (b) displaying part of said symbols of said respective symbol arrangements on a window having a predetermined winning line crossing over said symbol of said respective symbol arrangements to define said symbols positioned on said winning line as a symbol combination;
- (c) scrolling said symbols of said symbol arrangements within said window in a first predetermined scroll direction in response to a predetermined start instruction;
- (d) receiving a plurality of stop instructions corresponding to said plurality of symbol arrangements;
- (e) stopping scrolling said symbols of said symbol arrangements in response to said plurality of said stop instructions, respectively, received in the step (d) to bring the symbols of said corresponding symbol arrangements to a standstill on said winning line;
- (f) obtaining said symbol combination after all of said symbol arrangements are stopped scrolling in the step (e);
- (g) shifting said symbols of said symbol arrangements in said first scroll direction within a predetermined waiting time after the step (d);
- (h) shifting said symbols of said symbol arrangements in a second predetermined scroll direction different from said scroll direction within said waiting time;
- (i) performing the steps (g) and (h) to change said symbol combination; and
- (j) evaluating said symbol combination on the basis of a predetermined winning combination for winning, wherein the step (i) has the step of judging whether the symbol of each of said symbol arrangements positioned on said winning line is shifted or not on the basis of a predetermined game condition, the step (h) has the step of determining the number of shifting symbols of each of said symbol arrangements for shifting said symbols in said second scroll direction on the basis of said predetermined game condition, the step (g) has the step of determining the number of shifting symbols of each of said symbol arrangements for shifting said symbols in said first scroll direction on the basis of said number of symbols of each symbol arrangements for shifting said symbols in said second scroll direction in the step (h).

5. A method of controlling a game machine for allowing a player to play a game comprising the steps of:

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- (a) forming a plurality of predetermined symbol arrangements each having various kinds of symbols arranged in a predetermined order;
- (b) displaying part said symbols of said respective symbol arrangements on a window having a predetermined winning line crossing over said symbol of said respective symbol arrangements to define said symbols positioned on said winning line as a symbol combination;
- (c) scrolling said symbols of said symbol arrangements within said window in a first predetermined scroll direction in response to a predetermined start instruction;
- (d) receiving a plurality of stop instructions corresponding to said plurality of symbol arrangements;
- (e) stopping scrolling said symbols of said symbol arrangements in response to said plurality of said stop instructions, respectively, received in the step (d) to bring the symbols of said corresponding symbol arrangements to a standstill on said winning line;
- (f) obtaining said symbol combination after all of said symbol arrangements are stopped scrolling in the step (e);
- (g) shifting said symbols of said symbol arrangements in said first scroll direction within a predetermined waiting time after the step (d);
- (h) shifting said symbols of said symbol arrangements in a second predetermined scroll direction different from said first scroll direction within said waiting time;
- (i) performing the steps (g) and (h) to change said symbol combination;
- (j) evaluating said symbol combination on the basis of a predetermined winning combination for winning;
- (k) deciding a plan of the result of said game;
- (l) judging whether there is a chance to obtain the result of said game according to said plan decided in the step (k) within said waiting time or not; and
- (m) performing the step (i) so that the result of said game accords to said plan decided in the step (k).

6. The method as set forth in claim 3, in which said plan decided in the step (k) includes a plan of said symbol combination for evaluating, the step (l) having the step of judging whether the symbols of said symbol arrangement can be brought to a standstill on said winning line within said waiting time to obtain said symbol combination according to said plan decided in the step (k) or not, and the step (i) having the step of performing the step (h) to change said symbol combination in accordance with said plan decided in the step (k) when the judgment is made in the step (l) that the symbols of said symbol arrangement can be brought to a standstill on said winning line within said waiting time to obtain said symbol combination according to said plan decided in the step (k).

7. A game machine for allowing a player to play game comprising:

displaying means capable of displaying a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order;

scrolling means for allowing said displaying means to display part of said symbols of said symbol arrangement on a window having a predetermined winning point and to scroll said symbols within said window in the first predetermined scroll direction;

scrolling starting means for allowing said scrolling means to start to scroll said symbols within said window in

said first scroll direction in response to a predetermined start instruction;

receiving means for receiving a predetermined stop instruction;

scroll stopping mean for allowing said scrolling means to stop scrolling said symbols in response to said stop instruction received by said receiving means to bring one of said symbols to a standstill at said winning point;

shifting means for allowing said displaying means to shift said symbols in said first scroll direction and a second predetermined scroll direction different from said first scroll direction within a predetermined waiting time after said stop instruction is received by said receiving means to change the kind of the kind of the symbol positioned at said winning point; and

evaluating means for evaluating the kind of the symbol positioned at said winning point on the basis of a predetermined kind of symbol for winning,

wherein said shifting means is operated to judge whether the symbol positioned at said winning point is shifted or not on the basis of a predetermined game condition, to determine the number of shifting symbols for shifting said symbols in said second scroll direction on the basis of said predetermined game condition, and to determine the number of shifting symbols for shifting said symbols in said first scroll direction on the basis of the number of said shifting symbols for shifting said symbols in said second scroll direction.

8. A game machine for allowing a player to play a game comprising:

displaying means capable of displaying a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order;

scrolling means for allowing said displaying means to display part of said symbol arrangement on a window having a predetermined winning point and to scroll said symbols within said window in a first predetermined scroll direction;

scrolling starting means for allowing said scrolling means to start to scroll said symbols within said window in said first scroll direction in response to a predetermined start instruction;

receiving means for receiving a predetermined stop instruction;

scroll stopping mean for allowing said scrolling means to stop scrolling said symbols in response to said stop instruction received by said receiving means to bring one of said symbols to a standstill at said winning point;

shifting means for allowing said displaying means to shift said symbols in said first scroll directions and a second predetermined scroll direction different from said first scroll direction within a predetermined waiting time after said stop instruction is received by said receiving means to change the kind of the symbol positioned at said winning point;

evaluating means for evaluating the kind of the symbol positioned at said winning point on the basis of a predetermined kind of symbol for winning; and

deciding means for previously deciding a plan of the result of said game;

wherein said shifting means being operated to judge whether there is a chance to obtain the result of said game according to said plan decided by said deciding means within said waiting timer or not, and to shift said symbol in said first and second scroll directions so that

the result of said game accords to said plan decided by said deciding means.

9. The game machine as set forth in claim 8, in which said plan decided by said deciding means includes a plan of said kind of symbol for evaluating, and said shifting means is operated to judge whether the symbol of said symbol arrangement can be brought to a standstill at said winning point within said waiting time to obtain said symbol according to said plan decided by said deciding means or not, and to shift said symbol in said second scroll direction to change the kind of said symbol in accordance with said plan decided by said deciding means when the judgment is made that the symbol of said symbol arrangement can be brought to a standstill at said winning point within said waiting time to obtain said symbol according to said plan decided by said deciding means.

10. A method of controlling a game machine for allowing a player to play a game comprising the steps of:

- (a) forming a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order;
- (b) displaying part of said symbols of said symbol arrangement on a window;
- (c) scrolling said symbols within said window in a first predetermined scroll direction in response to a predetermined start instruction;
- (d) receiving a predetermined stop instruction;
- (e) stopping the scroll said symbols in response to said stop instructions received in the step (d) to bring one of said symbols to a standstill at a predetermined winning point provided with said window;
- (f) shifting said symbol in said first scroll direction within a predetermined waiting time after the step (d);
- (g) shifting said symbol in a second predetermined scroll direction different from said first scroll direction;
- (h) performing the steps (f) and (g) to change the kind of the symbol positioned at said winning point; and
- (i) evaluating the kind of the symbol positioned at said winning point on the basis of a predetermined kind of symbol for winning,

wherein the step (h) has the step of judging whether said symbol positioned at said winning point is shifted or not on the basis of a predetermined game condition, the step (g) has the step of determining the number of shifting symbols for shifting said symbols in said second scroll direction on the basis of said predetermined game condition, the step (f) has the step of determining the number of shifting symbols for shifting said symbols in said first scroll direction on the basis of said number of said shifting symbols for shifting said symbols in said second scroll direction in the step (g).

11. A method of controlling game machine for allowing a player to play a game comprising the steps of:

- (a) forming a predetermined symbol arrangement having various kinds of symbols arranged in a predetermined order;
- (b) displaying part of said symbols of said symbol arrangement on a window;
- (c) scrolling said symbols within said window in a first predetermined scroll direction in response to a predetermined start instruction;
- (d) receiving a predetermined stop instruction;
- (e) stopping the scroll said symbols in response to said stop instruction received in the step (d) to bring one of

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- said symbols to a standstill at a predetermined winning point provided with said window;
- (f) shifting said symbol in said first scroll direction within a predetermined waiting time after the step (d);
 - (g) shifting said symbol in a second predetermined scroll direction different from said first scroll direction;
 - (h) performing the steps (f) and (g) to change the kind of the symbol positioned at said winning point;
 - (i) evaluating the kind of the symbol positioned at said winning point on the basis of a predetermined kind of symbol for winning;
 - (j) deciding a plan of the result of said game;
 - (k) judging whether there is a chance to obtain the result of said game according to said plan decided in the step (j) within said waiting time or not; and

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- (l) performing the step (i) so that the result of said game accords to said plan decided in the step (j).

12. The method as set forth in claim 11, in which said plan decided in the step (j) includes a plan of said kind of symbol for evaluating, the step (k) has the step of judging whether the symbol of said symbol arrangement can be brought to a standstill at said winning point within said waiting time to obtain said symbol according to said plan decided in the step (j) or not, and the step (h) having the step of performing the step (g) to change the kind of said symbol in accordance with said plan decided in the step (j) when the judgment is made in the step (k) that the symbol of said symbol arrangement can be brought to a standstill at said winning point within said waiting time to obtain said symbol according to said plan decided in the step (j).

* * * * *



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/635,956	08/10/2000	Timothy C. Loose	47079-00058	6262

30223 7590 12/20/2002

JENKENS & GILCHRIST, P.C.
225 WEST WASHINGTON
SUITE 2600
CHICAGO, IL 60606

EXAMINER


COBURN, CORBETT B.

ART UNIT	PAPER NUMBER
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3714

DATE MAILED: 12/20/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/635,956	LOOSE, TIMOTHY C. 	
	Examiner	Art Unit	
	Corbett B. Coburn	3714	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-29 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>6</u> . | 6) <input type="checkbox"/> Other: |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
2. Claims 1-5 & 7-28 rejected under 35 U.S.C. 103(a) as obvious over McGlone et al. (US Patent Number 6,394,900)

Claims 1, 9, 20: McGlone teaches a slot machine with a central processing unit (422) for operating the slot machine in response to a wager. There is a reel mechanism including a motor (38) a symbol bearing reel (32) and a reel driver (402). The motor has a rotatable shaft upon which the reel is mounted. (Fig 1c) The reel driver includes a local microcontroller (612) distinct from and serially coupled to the CPU. (Fig 6) The reel driver is coupled to the motor to cause the motor to rotate the reel. (Abstract) The reel driver performs low-level reel driver operations independent from the CPU. (Fig 8) The CPU issues high-level commands to the to the reel driver related to the rotation of the reel. (Abstract) McGlone also teaches that the master gaming controller includes a memory storing software for device drivers for at least some of the slot reel peripherals. (Col 3, 35-41) These device drivers are configuration data and are sent to the local microprocessor for configuring it to a reel spinning game conducted with a slot machine.

Furthermore, McGlone teaches that, "The peripheral controller may have a non-volatile memory arranged to store configuration parameters specific to the slot reel peripheral and state history information of the slot reel peripheral. In one embodiment, the non-volatile memory might be used to store the configuration parameters needed to

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drive the slot reel using the drive mechanism including a moment of inertia of the slot reel, the size of the slot reel and one or more acceleration parameters.” (Col 3, 17-24)

The suggestion that the peripheral (i.e., local) controller may have non-volatile memory for storing configuration data provides a strong suggestion that the opposite may also be true. If the peripheral controller does not have non-volatile memory for storing configuration data, that data must be loaded to the peripheral controller from the central procession unit. Doing this would eliminate unnecessary duplication of parts because the data could be stored in one set of non-volatile memory instead of on non-volatile memory associated with each peripheral controller. This would reduce the cost of the gaming machine. It would have been obvious to one of ordinary skill in the art at the time of the invention to have the central processing unit send configuration data to the local microcontroller for configuring the microcontroller to a reel spinning game conducted with a slot machine in order to eliminated unnecessary duplication of parts, thus reducing costs.

Claim 2: Slot machines inherently stop the symbols in visual association with one or more paylines.

Claim 3: The low-level reel driver operations include monitoring the reel and at least partially controlling its position. (Abstract)

Claims 4, 11: The local microcontroller monitors the reel by sampling its state multiple times per second in real time and responds with control commands for controlling the position of the reel. (Col 8, 45-57)

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Claim 5: The local microcontroller is serially connected to the CPU via a Universal Serial Bus. (Col 2, 44-48)

Claims 7, 10: The CPU issues high-level commands to the local microcontroller. The high-level commands include a start reel command for starting the reel and a stop reel command for stopping the reel. (Col 7, 25-33, Col 8, 28-32)

Claim 8, 13: The reel includes an encoder (barcode) for indicating the position of the reel. The reel driver includes a barcode reader (408) that is coupled to the microcontroller so that the microcontroller may monitor the position of the reel. (Col 8, 45-57)

Claim 12: Claim 12 is merely a restatement of claims 1, 4, and 7, which see Above.

Claims 14, 16, 18, 21: McGlone teaches that the configuration data includes "parameters needed to drive the slot reel using the drive mechanism, including the moment of inertia of the slot reel, the size of the slot reel and one or more acceleration parameters." (Col 3, 21-24)

Claims 15, 17, 19, 22, 26, 27: As noted above, McGlone suggests transmission of configuration data by the CPU to the local microcontroller and processing of that data by the local microprocessor. McGlone also teaches communication between the local microcontroller and the CPU. (Col 3, 32-33) While McGlone fails to specifically teach communication of the status of configuration from the local processor to the CPU, it would be obvious to do so. If the local controller were misconfigured, errors could occur in the game. These errors could result in players winning when they should not win and losing when they should not lose. Neither of these conditions is acceptable to a casino.

For example, if the configuration data were for the wrong type of position decoder, it would be impossible to determine which symbols appear along a payline. It would have been obvious to one of ordinary skill in the art at the time of the invention to have communicated of the status of configuration from the local processor to the CPU and to have compared the configuration data with the determined type of position encoder in order to prevent the game machine from operating in a misconfigured condition that would lead to errors in the game.

Claim 23: McGlone teaches providing a physical symbol-bearing reel (Fig 1b) including an encoder (410) for indicating the position of the reel. (Col 1, 43-44) McGlone teaches providing a reel controller for performing low-level operations related to the movement of the reel. (Fig 8) There is also a CPU for issuing high-level commands to the reel controller related to the movement of the reels. (Abstract) McGlone also teaches that the microcontroller that operates the reels must have the parameters and operation features of the position sensor in order to operate the reels. (Col 1, 42-48, Col 2, 66 – Col 3, 4) The peripheral controller receives device drivers for operating some of the peripherals from the CPU. (Col 3, 34-41) This would include the position encoder since the position encoder is necessary for the operation the slot machine. In order to determine which of the various device drivers to download, it would be necessary for the reel controller to determine the type of encoder present and to report it to the CPU. It would have been obvious to one of ordinary skill in the art at the time of the invention to have the CPU send a command to the reel controller to determine the type of position encoder present in order to download the correct device drivers to the reel controller.

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Claim 24: McGlone teaches encoders with one or more flags (i.e., tabs). (Col 8, 52-54)

Thus the type of the encoder is based on the number of flags on the encoder.

Claim 25: As pointed out in connection with claim 23 above, in order to download the correct device driver, it is necessary to determine the type of encoder being used.

Claim 26: As pointed out in connection with claim 24 above, there are different types of position encoders. The number of flags or tabs on the encoder determines the type of the encoder. As pointed out in connection with claim 23, the machine must determine the type of encoder present in order to correctly configure the device by downloading the correct device drivers. The easiest way to determine the type of encoder present would be to cause the motor to spin and count the number of flags on the encoder. Thus it would have been obvious to one of ordinary skill in the art at the time of the invention to have caused the motor to spin the reel and detect the physical characteristics (i.e., the number of flags) of the encoder in order to determine which type of encoder was present, thus enabling the loading of the correct device driver.

3: Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over McGlone in view of Heidel et al. (US Patent Number 5,102,136)

Claim 6: McGlone teaches a slot machine with a central processing unit (422) for operating the slot machine in response to a wager. There is a reel mechanism including a motor (38) a symbol bearing reel (32) and a reel driver (402). The motor has a rotatable shaft upon which the reel is mounted. (Fig 1c) The reel driver includes a local microcontroller (612) distinct from and serially coupled to the CPU. (Fig 6) The reel driver is coupled to the motor to cause the motor to rotate the reel. (Abstract) The reel

driver performs low-level reel driver operations independent from the CPU. (Fig 8) The CPU issues high-level commands to the to the reel driver related to the rotation of the reel. (Abstract) McGlone also teaches that the master gaming controller includes a memory storing software for device drivers for at least some of the slot reel peripherals. (Col 3, 35-41) These device drivers are configuration data and are sent to the local microprocessor for configuring it to a reel spinning game conducted with a slot machine. McGlone does not, however, specifically teach that the reel driver includes a printed circuit board to which the microcontroller is mounted. The use of printed circuit boards is so well known as to be notorious. McGlone specifically teaches that electrical components are usually mounted on printed circuit boards. (Col 2, 10-14) Printed circuit boards provide a stable physical substrate upon which circuit components may be mounted. Heidel teaches a reel controller circuit board (84) that is oriented generally perpendicular to the axis of rotation of the reel. Mounting the reel controller circuit board generally perpendicular to the axis of rotation of the reel allows the assembly to be compact. It would have been obvious to one of ordinary skill in the art at the time of the invention to have mounted the microcontroller on a printed circuit board that is mounted generally perpendicularly to the axis of rotation of the reel in order to provide a stable physical substrate for the electrical components with a compact configuration.

4. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over McGlone in view of Sakamoto (US Patent Number 6,315,663).

Claim 29: McGlone teaches providing a physical symbol-bearing reel (Fig 1b) including an encoder (410) for indicating the position of the reel. (Col 1, 43-44) McGlone teaches

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providing a reel controller for performing low-level operations related to the movement of the reel. (Fig 8) There is also a CPU for issuing high-level commands to the reel controller related to the movement of the reels. (Abstract) McGlone teaches that the reel controller has "configuration parameters needed to drive the slot machine using the drive mechanism including a moment of inertia, the size of the slot reel and one or more acceleration parameters." (Col 3, 21-24) But McGlone does not teach an acceleration or deceleration profile for accelerating or decelerating the reel. Sakamoto teaches an acceleration or deceleration profile for accelerating or decelerating the reel. (Col 12, 40-61) Having the reels accelerate and decelerate at varying speeds add visual interest to the slot machine game. It would have been obvious to one of ordinary skill in the art at the time of the invention to have the CPU send high-level commands concerning acceleration or deceleration profile for accelerating or decelerating the reel to the reel controller in order to add visual interest to the slot machine game.

Response to Arguments

5. Applicant's arguments with respect to claims 1-13 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Corbett B. Coburn whose telephone number is (703) 305-3319. The examiner can normally be reached on 8-5:30, Monday-Friday, alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Hughes can be reached on (703) 308-1806. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9302 for regular communications and (703) 872-9303 for After Final communications.

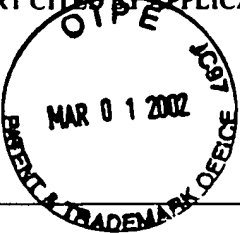



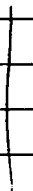
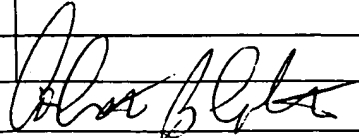
Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1148.

cbc

cbc
December 16, 2002



JESSICA HARRISON
PRIMARY EXAMINER

Form PTO-1449 (modified) LIST OF PRIOR ART CITED BY APPLICANT <div style="text-align: center;">  </div>				Application No.: 09/635,956 Filing Date: August 10, 2000 First Named Inventor: Timothy C. Loose Group Art Unit: Not Assigned Examiner: 3713 Attorney Docket No.: 47079-00058			
Sheet 1 of 1							
U.S. PATENT DOCUMENTS							
Examiner Initial	Ref.	Document Number	Date	Name	Class	Sub-Class	Filing Date (if Application)
 	A5	4,688,020	08/18/1987	Kuehneman et al.	340	365 VL	
	A6	4,692,571	09/08/1987	Trinh et al.	200	5 A	
	A7	5,579,002	11/26/1996	Iggulden et al.	341		
FOREIGN PATENT DOCUMENTS							
Examiner Initial	Ref.	Document Number	Date	Country	Class	Sub-Class	Translation Yes/No
 	B1	EP 0 738 991 A2	10/23/1996	EPO	G07F	17/32	N/A
	B2	FR 2 656 736 A1	07/05/1991	France	H01H	13/70	Abstract
	B3	WO 94/24683	10/27/1994	PCT	H01H	13/02	N/A
	B4	WO 99/61994	12/02/1999	PCT	G06F	13/12	N/A
	B5	GB 2 091 014 A	07/21/1982	U.K.	G07F	17/34	N/A
	B6	GB 2 326 505 A	12/23/1998	U.K.	G07F	17/32	N/A
OTHER DOCUMENTS (including author, title, date, pertinent pages, etc.)							
Examiner Initial	Ref.	Document Information					
EXAMINER 		DATE CONSIDERED 16 Dec 02					

*Examiner: Initial if citations considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Notice of References Cited

Application/Control No.

09/635,956

Applicant(s)/Patent Under

Reexamination

LOOSE, TIMOTHY C.

Examiner

Corbett B. Coburn

Art Unit

3714

Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,315,663	11-2001	Sakamoto, Yoshikazu	463/20
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/635,956	08/10/2000	Timothy C. Loose	47079-00058	6262

30223 7590 03/07/2003

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EXAMINER

COBURN, CORBETT B

ART UNIT

PAPER NUMBER

3714

DATE MAILED: 03/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Advisory Action

Application No.

09/635,956

Applicant(s)

LOOSE, TIMOTHY C.

Examiner

Corbett B. Coburn

Art Unit

3714

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 19 February 2003 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE. Therefore, further action by the applicant is required to avoid abandonment of this application. A proper reply to a final rejection under 37 CFR 1.113 may only be either: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114.

PERIOD FOR REPLY [check either a) or b)]

- a) ☐ The period for reply expires _____ months from the mailing date of the final rejection.
- b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection. ONLY CHECK THIS BOX WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

1. ☐ A Notice of Appeal was filed on _____. Appellant's Brief must be filed within the period set forth in 37 CFR 1.192(a), or any extension thereof (37 CFR 1.191(d)), to avoid dismissal of the appeal.
2. ☒ The proposed amendment(s) will not be entered because:
- (a) ☐ they raise new issues that would require further consideration and/or search (see NOTE below);
- (b) ☐ they raise the issue of new matter (see Note below);
- (c) ☒ they are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
- (d) ☐ they present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: _____

3. ☐ Applicant's reply has overcome the following rejection(s): _____.
4. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
5. ☐ The a) ☐ affidavit, b) ☐ exhibit, or c) ☐ request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
6. ☐ The affidavit or exhibit will NOT be considered because it is not directed SOLELY to issues which were newly raised by the Examiner in the final rejection.
7. ☒ For purposes of Appeal, the proposed amendment(s) a) ☒ will not be entered or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

The status of the claim(s) is (or will be) as follows:


Claim(s) allowed: _____

Claim(s) objected to: _____

Claim(s) rejected: 1-29.

Claim(s) withdrawn from consideration: _____

8. ☐ The proposed drawing correction filed on _____ is a) ☐ approved or b) ☐ disapproved by the Examiner.
9. ☐ Note the attached Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
10. ☒ Other: See Attached


S. THOMAS HUGHES
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 19 February 2003 have been fully considered and are not persuasive.
2. Applicant argues that device drivers are not configuration data. This is in error. Applicant makes a great deal of the fact that device drivers are programs. This is true – but programs **are** data. Furthermore, no device driver can function without data on the configuration of a particular piece of hardware. By loading the device drivers for a particular set of peripheral hardware, McGlone is loading configuration data.
3. Applicant states that it would not reduce the number of parts or cost to have the configuration data downloaded by the CPU to the reel controllers. This is opinion and is not supported by any evidence. Examiner has made a prima face case of obviousness. If Applicant believes that the asserted reasons to combine are in error, Applicant must present evidence that the reason to combine is in error.
4. Applicant states that, "significant motivation exists for not reporting a status of configuration of the local microcontroller back to the CPU." Again, this is a statement unsupported by evidence.
5. Applicant argues that McGlone "teaches away" from spinning the reel to determine the type of encoder associated therewith. Applicant is under a misconception concerning the meaning of "teaches away". When a reference "teaches away" from a concept, it teaches that the concept cannot work. A reference that teaches another way of achieving a desired result does not necessarily "teach away" from other methods of achieving the result.

6. Applicant argues that McGlone “teaches away” from the CPU issuing a high-level command for informing the reel controller of an acceleration or deceleration profile. Again, McGlone does not “teach away” from this concept. McGlone does not teach a high-level command for informing the reel controller of an acceleration or deceleration profile because McGlone’s slot machine does not have the acceleration/deceleration profile feature. By the same token, McGlone does not teach that the slot machine cannot have this feature. Sakomoto teaches this feature. The acceleration/deceleration profile feature adds to the visual appeal of the slot machine. It cannot be implemented unless the reel controller has the profile supplied to it by the CPU.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Corbett B. Coburn whose telephone number is (703) 305-3319. The examiner can normally be reached on 8-5:30, Monday-Friday, alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Tom Hughes can be reached on (703) 308-1806. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9302 for regular communications and (703) 872-9303 for After Final communications.

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Page 4

Art Unit: 3714

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1148.

A handwritten signature in black ink, appearing to be 'CBC' followed by a stylized flourish.

cbc

March 4, 2003

(Cite as: 2002 WL 1801466 (Bd.Pat.App & Interf.))

Board of Patent Appeals and Interferences

Patent and Trademark Office (P.T.O.)

*1 EX PARTE FRANCIS J. MAGUIRE, JR.

Appeal No. 1999-1344

Application No. 08/364,718

NO DATE REFERENCE AVAILABLE FOR THIS DOCUMENT

FRANCIS J. MAGUIRE

WARE FRESSOLA VAN DER SLUYS & ADOLPHSON

755 MAIN STREET

MONROE, CT 06468

Before FLEMING, HAIRSTON and GROSS

Administrative Patent Judges

Fleming

Administrative Patent Judge

ON BRIEF

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the final rejection of claims 1-8, all the claims pending in the application.

The instant invention discloses an eye tracking method and apparatus that provides a new way to monitor the eye with respect to more than one coordinate system. An eye attitude monitor is combined with a head translatory position monitor in order to relate the eye translatory position as well as its attitude to an arbitrarily selected reference coordinate system. Appellant's specification ("Specification"), page 3. The term "attitude" means the angular rotations of an eye visual axis with respect to arbitrarily selected axes of an eye coordinate system. Specification, page 6. Eye attitude can mean up to three axes of rotation (pitch, roll, yaw) about an origin of an eye coordinate system. Specification, page 4. A head attitude monitor is added to relate the attitude of the eye to the arbitrarily selected reference coordinate system. Specification, page 7. The eye tracking apparatus tracks the attitude of one or both eyes with respect to a head attached to a body. Specification, page 4. The origin of the eye coordinate system is fixed in relation to the origin of a head coordinate system. Specification, page 2. The attitude of the head is monitored with respect to a selected first coordinate system such as the body. Specification, page 6, line 32, to page 7, line 1. The monitors provide sensed signals to a computer. Specification, page 7.

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The computer inputs the signals to perform eye-head coordinate transformations and provides a tracking or visual axis signal to a control device. Specification, page 8. The control device produces a signal that may be used for many purposes including positioning an image artifact and target acquisition for controlling a projectile. Specification, page 8.

Appellant's independent claim 1, reproduced below, is representative of the invention:

1. Apparatus, comprising:

an eye monitor, responsive to an eye direction, for providing an eye direction signal with respect to an associated head coordinate system;

a head translatable position monitor, responsive to a translatable position associated with a head translating with respect to a reference coordinate system, for providing a head translatable position signal;

a signal processor, responsive to the eye direction signal and the head translatable position signal, for providing the eye direction signal referenced to the reference coordinate system with respect to both head translatable position and eye direction; and

*2 a control, responsive to the eye direction signal referenced to the reference coordinate signal, for providing a control signal.

In rejecting Appellant's claims, the Examiner relies on two references:

Lewis	4,028,725	Jun. 7, 1977
Beckman	5,383,990	Feb. 14, 1995
		(filed Apr. 23, 1993)

Claims 1-8 stand rejected under 35 U.S.C. § 103 as obvious over Lewis and Beckman. Rather than repeat the arguments of Appellant and Examiner, we refer the reader to the Appellant's Briefs [FN1] and Examiner's Answer [FN2] for the respective details thereof.

OPINION

With full consideration being given the subject matter on appeal, the Examiner's rejection and the arguments of Appellant and Examiner, for the reasons stated *infra*, we will reverse the Examiner's rejection of claims 1-8 under 35 U.S.C. § 103 as obvious over Lewis and Beckman.

In rejecting claims under 35 U.S.C. § 103, the Examiner bears the initial burden of establishing a *prima facie* case of obviousness. In *re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). See also *In re Piasecki*, 745 F.2d 1468, 1471-72, 223 USPQ 785, 788 (Fed. Cir. 1984)). The Examiner can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. In *re Fine*, 837 F.2d 1071,

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1074, 5 USPQ2d 1596, 1598. Only if this initial burden is met does the burden of coming forward with evidence or argument shift to the Appellant. See Oetiker, 977 F.2d at 1445, 24 USPQ2d at 1444. See also Piasecki, 745 F.2d at 1472, 223 USPQ at 788 ("After a prima facie case of obviousness has been established, the burden of going forward shifts to the applicant."). If the examiner fails to establish a prima facie case, the rejection is improper and accordingly merits reversal. In re Fine, 837 F.2d at 1074, 5 USPQ2d at 1598.

An obviousness analysis commences with a review and consideration of all the pertinent evidence and arguments. See Oetiker, 977 F.2d at 1445, 24 USPQ2d at 1444 ("In reviewing the examiner's decision on appeal, the Board must necessarily weigh all of the evidence and argument."). Accordingly, we now consider the claims on appeal.

*3 In traversing the Examiner's rejection of the claims, the Appellant first argues that Beckman only discloses the monitoring of head attitude and actually teaches the suppression of the translatory position information from a head sensor. Brief at page 6. Next, Appellant asserts that there is no motivation to use sensed head translations with eye monitoring to be found in Lewis or Beckman either alone or in combination. Appellant argues that "[t]he speculations of the Examiner with regard to providing greater accuracy and enhanced control by using head translations do not come from Lewis or Beckman but from the Examiner." Brief at page 6. Additionally, Appellant asserts that Beckman and Lewis teach sensing head attitude, not head position. Brief at page 9. Finally, Appellant asserts that neither Lewis nor Beckman enables the signal processing carried out by the claimed signal processor. Brief at page 9.

The Examiner maintains that Lewis teaches an eye monitor, position monitor, signal processor and control. Examiner's Answer at page 3. However, the Examiner looks to the Beckman reference for the teaching of head translational movement and asserts that it would have been obvious to one having ordinary skill in the art to utilize the Beckman method for sensing both the translational and angular movements of the traveler's head in the monitoring system taught by Lewis to provide an accurate virtual image of a scene surrounding a vehicle because a virtual reality control system would sense the position and orientation of the traveler's head and adjust the projection parameters to maintain the illusion that the traveler is immersed in a real scene. Examiner's Answer at page 4.

We find that Lewis enables a means of coordinating the movement or control of a remote sensor with the movement of the remote observer's head or eyes. See Lewis, column 1, lines 23-26. Lewis teaches a high resolution vision system in which remotely located sensors controlled by head and eye tracking means generate signals that are transmitted to signal processing means on the helmet to produce a display image having a wide field of view that is maintained on the operator's line of sight. See Lewis, column 1, lines 10-13. Beckman teaches a virtual reality flight control system having six degrees of freedom of acceleration or velocity control. Beckman, column 4, lines 30-35.

However, we find no objective teaching in either Lewis or Beckman that would lead one of ordinary skill in the art to combine the references. Lewis relates to the sensing of images outside an actual aircraft and addresses the problem of remotely sensing and displaying images within a pilot's focus. Consequently, Lewis' reference system merely involves the pilot's line-of-sight (LOS). Beckman involves a virtual reality flight control system and addresses the problem of

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flight simulation in outer space. Therefore, Beckman uses six degrees of freedom in a more complicated reference coordinate system that permits greater combinations of translations and rotations. Beckman and Lewis are directed to disparate teachings which address different problems and we find no reason or suggestion in either prior art reference to enable their combination in this obviousness analysis. We conclude therefore that the Examiner has failed to establish a prima facie case of obviousness.

*4 When an obviousness determination is based on multiple prior art references, there must be a showing of some "teaching, suggestion, or reason" to combine the references. *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1348, 53 USPQ2d 1580, 1586 (Fed. Cir.) cert. denied, 530 U.S. 1238 (2000). The Federal Circuit further instructs that "[t]he mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266 n.14, 23 USPQ2d 1780, 1783- 84 n.14 (Fed. Cir. 1992), citing *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984). It is further established that "such a suggestion may come from the nature of the problem to be solved, leading inventors to look to references relating to possible solutions to that problem." *Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc.*, 75 F.3d 1568, 1573, 37 USPQ2d 1626, 1630 (Fed. Cir. 1996), citing *In re Rinehart*, 531 F.2d 1048, 1054, 189 USPQ 143, 149 (CCPA 1976) (considering the problem to be solved in a determination of obviousness). The Federal Circuit reasons in *Para-Ordnance Mfg. Inc. v. SGS Importers Int'l Inc.*, 73 F.3d 1085, 1088-89, 37 USPQ2d 1237, 1239-40 (Fed. Cir. 1995), cert. denied, 519 U.S. 822 (1996) that for the determination of obviousness, the court must answer whether one of ordinary skill in the art who sets out to solve the problem and who had before him in his workshop the prior art, would have been reasonably expected to use the solution that is claimed by the Appellant. However, "[o]bviousness may not be established using hindsight or in view of the teachings or suggestions of the invention." *Para-Ordnance*, 73 F.3d at 1087, 37 USPQ2d at 1239, citing *W.L. Gore & Assocs., Inc. v. Garlock Inc.*, 721 F.2d 1540, 1548, 220 USPQ 303, 309 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984). In addition, our reviewing court requires the Patent and Trademark Office to make specific findings on a suggestion to combine prior art references. *In re Dembiczak*, 175 F.3d 994, 1000-01, 50 USPQ2d 1614, 1617-19 (Fed. Cir. 1999). "The combination of elements from non- analogous sources, in a manner that reconstructs the applicant's invention only with the benefit of hindsight, is insufficient to present a prima facie case of obviousness." *Oetiker*, 977 F.2d at 1445, 24 USPQ2d at 1446.

*5 Based on the evidence and arguments presented, and the pertinent law in this matter, we find that the Examiner has failed to establish a prima facie case of unpatentability with respect to claims 1-8. Accordingly, we reverse the Examiner's rejections of claims 1-8 as unpatentable over Lewis and Beckman.

REVERSED

BOARD OF PATENT APPEALS AND INTERFERENCES

MICHAEL R. FLEMING

Administrative Patent Judge

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KENNETH W. HAIRSTON

Administrative Patent Judge

ANITA PELLMAN GROSS

Administrative Patent Judge

FN1. Appellant filed an Appeal Brief ("Brief") on April 30, 1998. In response to the Examiner's Answer, Appellant filed a Reply Brief on August 27, 1998.

FN2. The Examiner, in response to Appellant's Brief, filed an Examiner's Answer on June 24, 1998.

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END OF DOCUMENT

Date of Printing: JUN 06,2003

KEYCITE

CITATION:EX PARTE FRANCIS J. MAGUIRE, JR., 2002 WL 1801466 (Bd.Pat.App & Interf., 2002) (NO. APL 1999-1344, APP 081364,718)

History

- => 1 **EX PARTE FRANCIS J. MAGUIRE, JR.**, 2002 WL 1801466 (Bd.Pat.App & Interf. 2002)
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Citing References

No references were found within the scope of KeyCite's citing case coverage.

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Last modified: Friday, February 08, 2002

A program that controls a device. Every device, whether it be a printer, disk drive, or keyboard, must have a driver program. Many drivers, such as the keyboard driver, come with the operating system. For other devices, you may need to load a new driver when you connect the device to your computer. In DOS systems, drivers are files with a .SYS extension. In Windows environments, drivers often have a .DRV extension.

A driver acts like a translator between the device and programs that use the device. Each device has its own set of specialized commands that only its driver knows. In contrast, most programs access devices by using generic commands. The driver, therefore, accepts generic commands from a program and then translates them into specialized commands for the device.

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Last modified: Monday, December 03, 2001

(1) Distinct pieces of information, usually formatted in a special way. All software is divided into two general categories: *data* and *programs*. Programs are collections of instructions for manipulating data.

Data can exist in a variety of forms -- as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind.

Strictly speaking, data is the plural of *datum*, a single piece of information. In practice, however, people use *data* as both the singular and plural form of the word.

(2) The term *data* is often used to distinguish binary machine-readable information from textual human-readable information. For example, some applications make a distinction between *data files* (files that contain binary data) and *text files* (files that contain ASCII data).

(3) In database management systems, data files are the files that store the database information, whereas other files, such as index files and data dictionaries, store administrative information, known as metadata.

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Data

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